Fig.1

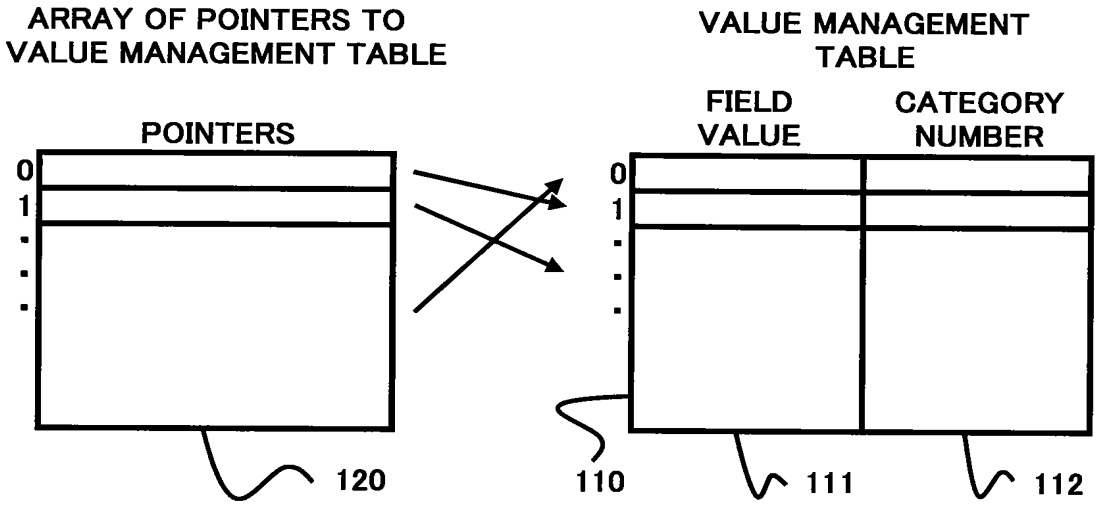
ARRAY OF POINTERS TO VALUE MANAGEMENT TABLE
VALUE MANAGEMENT TABLE
POINTERS
FIELD VALUE
CATEGORY NUMBER
0
1
0
1
120
110
111
112

Fig.2

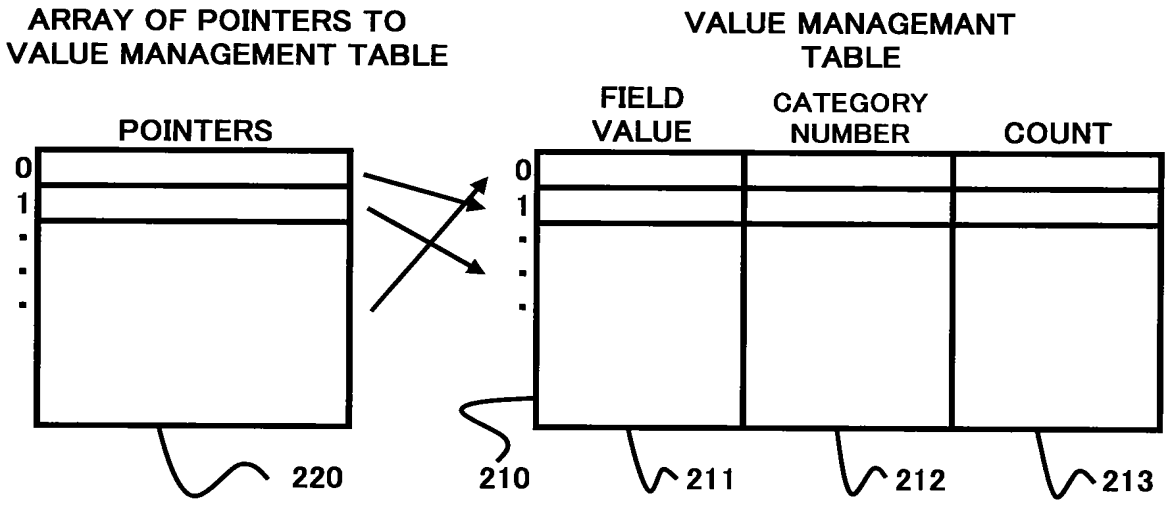
ARRAY OF POINTERS TO VALUE MANAGEMENT TABLE
VALUE MANAGEMANT TABLE
POINTERS
FIELD VALUE
CATEGORY NUMBER
COUNT
0
1
0
1
220
210
211
212
213

Fig.3

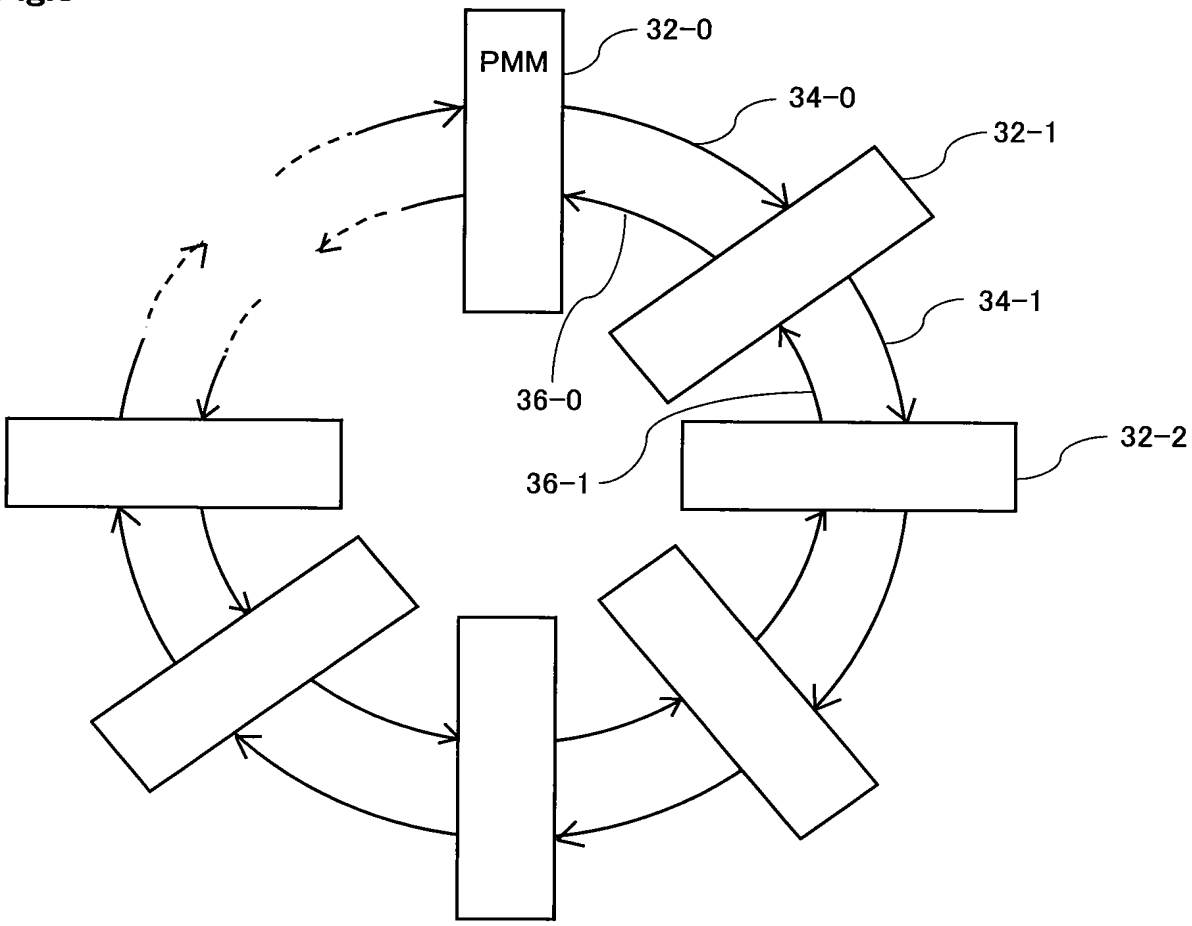

Fig.4

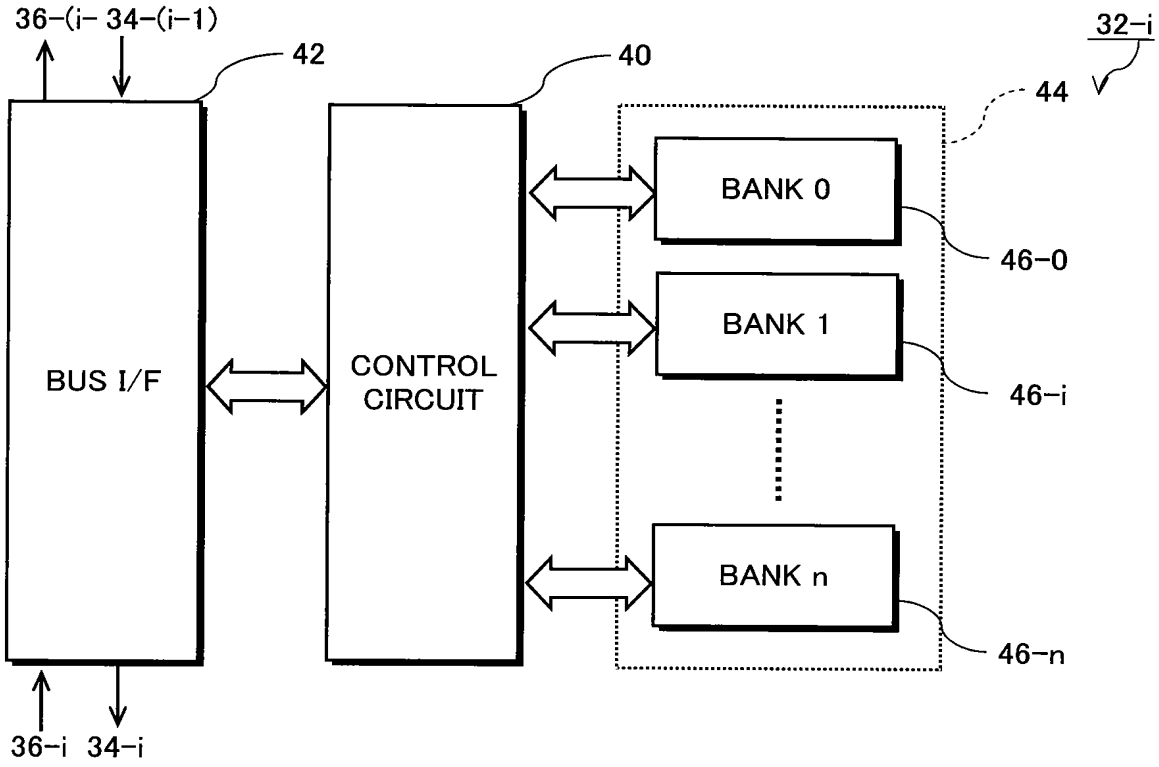
36-(i-
34-(i-1)
42
40
32-i
44
BANK 0
46-0
BANK 1
46-i
BUS I/F
CONTROL CIRCUIT
BANK n
46-n
36-i
34-i

Fig.5

RECORD NUMBER	SEX	AGE	HEIGHT(cm)
0	FEMALE	3	78
1	MALE	1	82
2	FEMALE	2	69
3	FEMALE	1	82
4	MALE	3	91
5	FEMALE	1	76
6	FEMALE	1	78
7	FEMALE	2	84
8	MALE	3	87
9	FEMALE	3	80

Fig.6

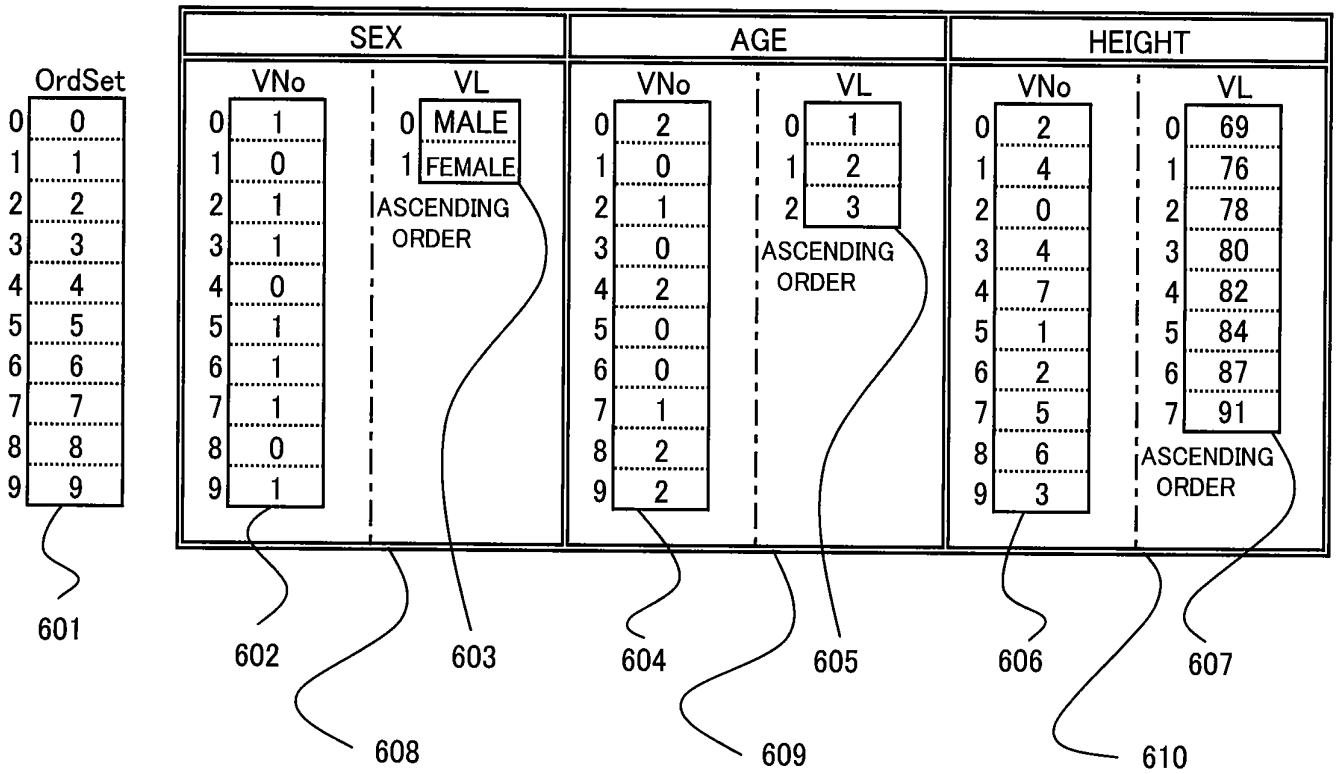
SEX
AGE
HEIGHT
OrdSet
VNo
VL
MALE
FEMALE
ASCENDING ORDER
ASCENDING ORDER
ASCENDING ORDER
601
602
603
604
605
606
607
608
609
610

Fig.7

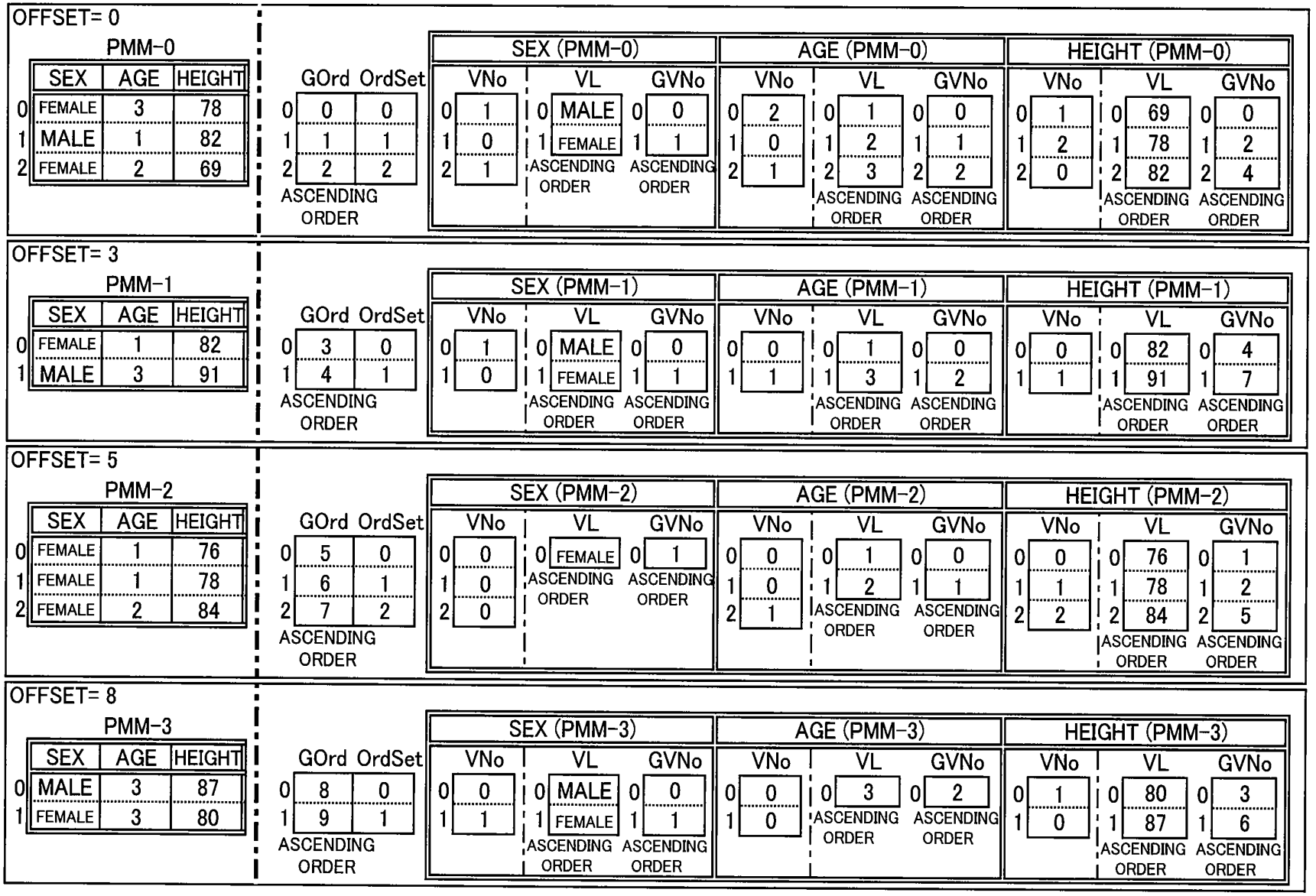
OFFSET= 0
PMM-0
SEX | AGE | HEIGHT
0 FEMALE 3 78
1 MALE 1 82
2 FEMALE 2 69
GOrd OrdSet
0 0 0
1 1 1
2 2 2
ASCENDING ORDER
SEX (PMM-0)
VNo: 0 1, 1 0, 2 1
VL: 0 MALE, 1 FEMALE
GVNo: 0 0, 1 1
ASCENDING ORDER
AGE (PMM-0)
VNo: 0 2, 1 0, 2 1
VL: 0 1, 1 2, 2 3
GVNo: 0 0, 1 1, 2 2
ASCENDING ORDER
HEIGHT (PMM-0)
VNo: 0 1, 1 2, 2 0
VL: 0 69, 1 78, 2 82
GVNo: 0 0, 1 2, 2 4
ASCENDING ORDER
OFFSET= 3
PMM-1
SEX | AGE | HEIGHT
0 FEMALE 1 82
1 MALE 3 91
GOrd OrdSet
0 3 0
1 4 1
ASCENDING ORDER
SEX (PMM-1)
VNo: 0 1, 1 0
VL: 0 MALE, 1 FEMALE
GVNo: 0 0, 1 1
ASCENDING ORDER
AGE (PMM-1)
VNo: 0 0, 1 1
VL: 0 1, 1 3
GVNo: 0 0, 1 2
ASCENDING ORDER
HEIGHT (PMM-1)
VNo: 0 0, 1 1
VL: 0 82, 1 91
GVNo: 0 4, 1 7
ASCENDING ORDER
OFFSET= 5
PMM-2
SEX | AGE | HEIGHT
0 FEMALE 1 76
1 FEMALE 1 78
2 FEMALE 2 84
GOrd OrdSet
0 5 0
1 6 1
2 7 2
ASCENDING ORDER
SEX (PMM-2)
VNo: 0 0, 1 0, 2 0
VL: 0 FEMALE
GVNo: 0 1
ASCENDING ORDER
AGE (PMM-2)
VNo: 0 0, 1 0, 2 1
VL: 0 1, 1 2
GVNo: 0 0, 1 1
ASCENDING ORDER
HEIGHT (PMM-2)
VNo: 0 0, 1 1, 2 2
VL: 0 76, 1 78, 2 84
GVNo: 0 1, 1 2, 2 5
ASCENDING ORDER
OFFSET= 8
PMM-3
SEX | AGE | HEIGHT
0 MALE 3 87
1 FEMALE 3 80
GOrd OrdSet
0 8 0
1 9 1
ASCENDING ORDER
SEX (PMM-3)
VNo: 0 0, 1 1
VL: 0 MALE, 1 FEMALE
GVNo: 0 0, 1 1
ASCENDING ORDER
AGE (PMM-3)
VNo: 0 0, 1 0
VL: 0 3
GVNo: 0 2
ASCENDING ORDER
HEIGHT (PMM-3)
VNo: 0 1, 1 0
VL: 0 80, 1 87
GVNo: 0 3, 1 6
ASCENDING ORDER

Fig.8

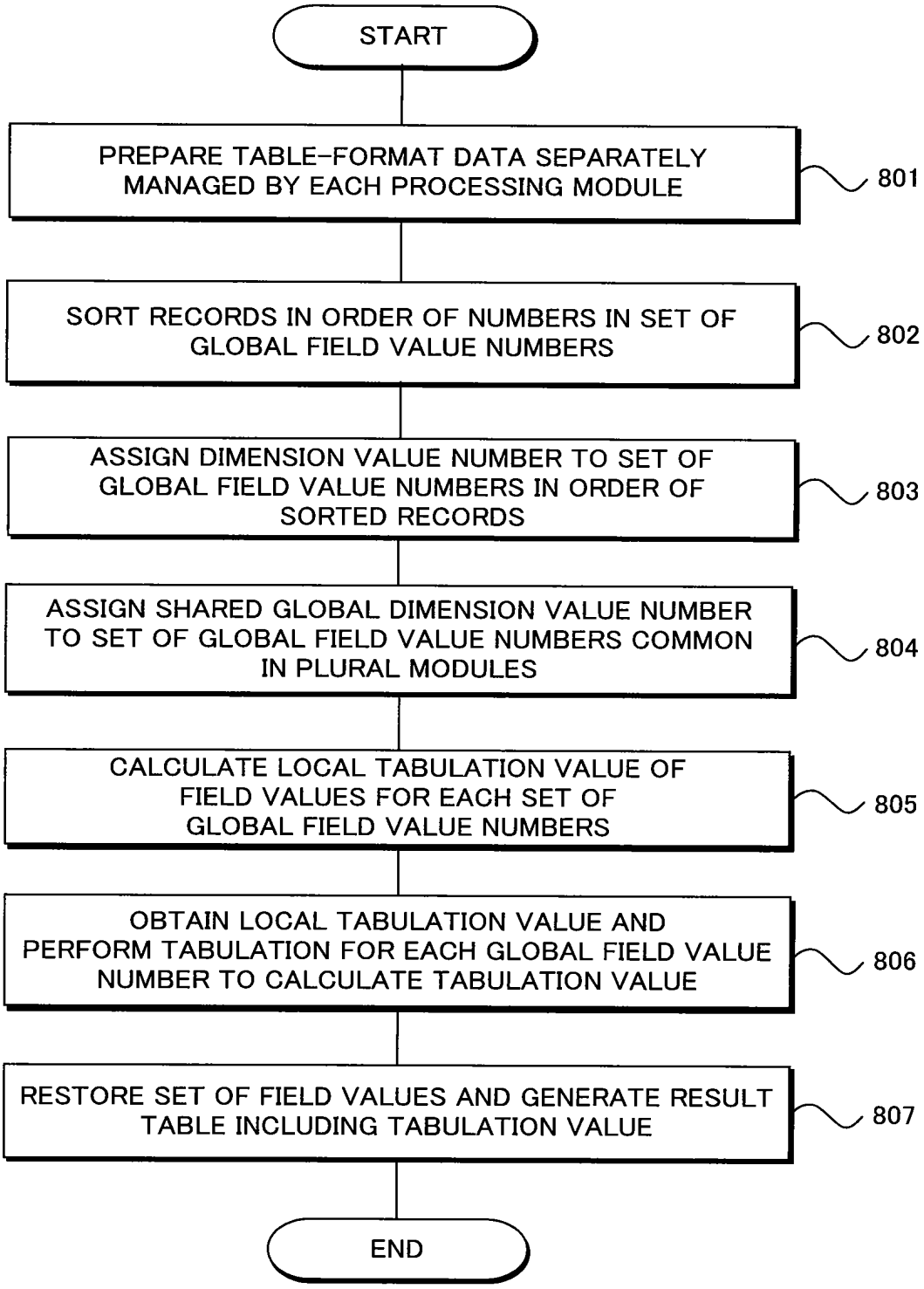
START
PREPARE TABLE-FORMAT DATA SEPARATELY MANAGED BY EACH PROCESSING MODULE
801
SORT RECORDS IN ORDER OF NUMBERS IN SET OF GLOBAL FIELD VALUE NUMBERS
802
ASSIGN DIMENSION VALUE NUMBER TO SET OF GLOBAL FIELD VALUE NUMBERS IN ORDER OF SORTED RECORDS
803
ASSIGN SHARED GLOBAL DIMENSION VALUE NUMBER TO SET OF GLOBAL FIELD VALUE NUMBERS COMMON IN PLURAL MODULES
804
CALCULATE LOCAL TABULATION VALUE OF FIELD VALUES FOR EACH SET OF GLOBAL FIELD VALUE NUMBERS
805
OBTAIN LOCAL TABULATION VALUE AND PERFORM TABULATION FOR EACH GLOBAL FIELD VALUE NUMBER TO CALCULATE TABULATION VALUE
806
RESTORE SET OF FIELD VALUES AND GENERATE RESULT TABLE INCLUDING TABULATION VALUE
807
END

Fig.9

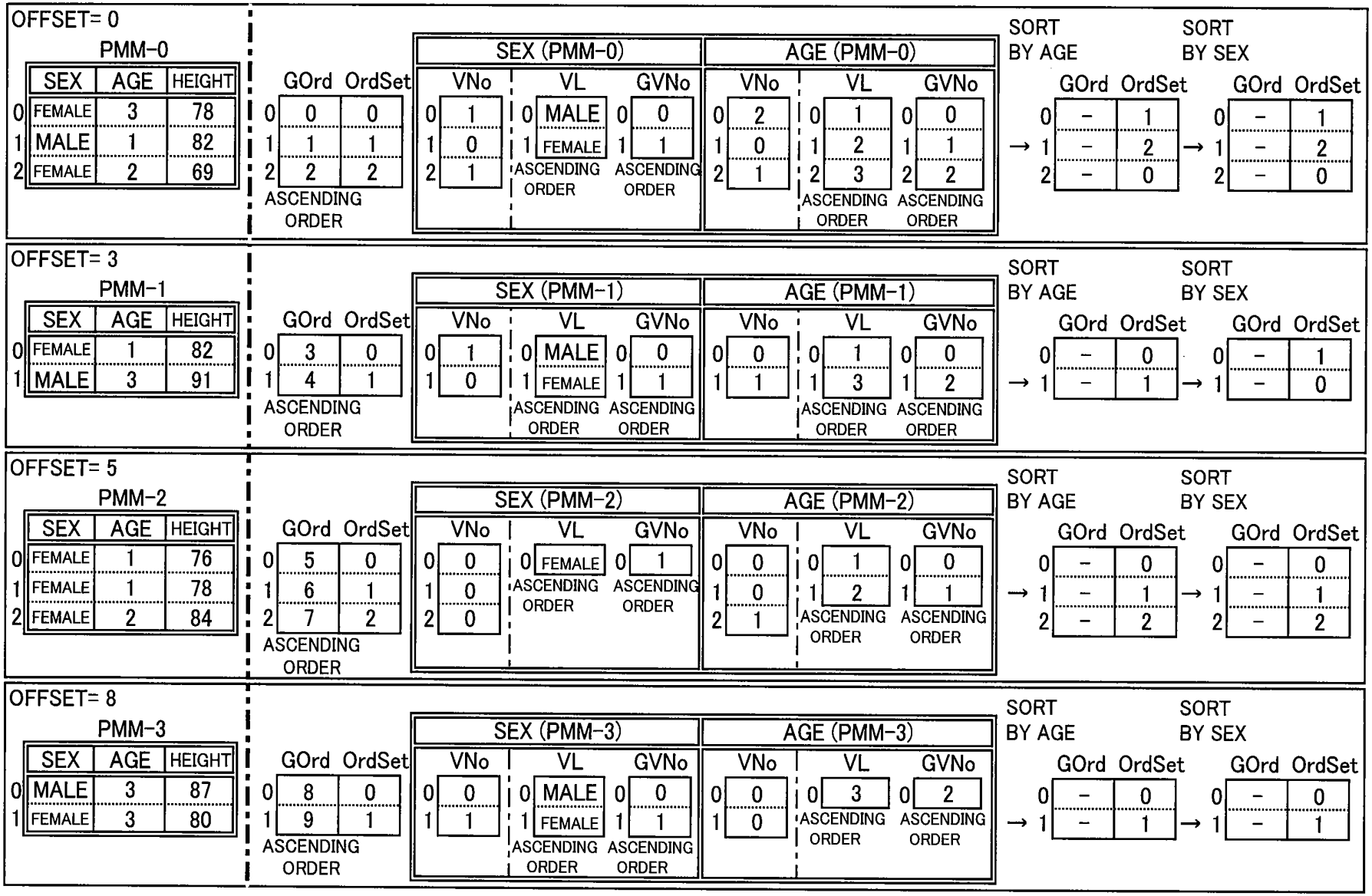
OFFSET= 0
PMM-0
SEX AGE HEIGHT
0 FEMALE 3 78
1 MALE 1 82
2 FEMALE 2 69
GOrd OrdSet
0 0 0
1 1 1
2 2 2
ASCENDING ORDER
SEX (PMM-0)
VNo VL GVNo
0 1 0 MALE 0
1 0 1 FEMALE 1
2 1 ASCENDING ORDER ASCENDING ORDER
AGE (PMM-0)
VNo VL GVNo
0 2 0 1 0 0
1 0 1 2 1 1
2 1 2 3 2 2
ASCENDING ORDER ASCENDING ORDER
SORT BY AGE
GOrd OrdSet
0 - 1
→ 1 - 2
2 - 0
SORT BY SEX
GOrd OrdSet
0 - 1
→ 1 - 2
2 - 0
OFFSET= 3
PMM-1
SEX AGE HEIGHT
0 FEMALE 1 82
1 MALE 3 91
GOrd OrdSet
0 3 0
1 4 1
ASCENDING ORDER
SEX (PMM-1)
VNo VL GVNo
0 1 0 MALE 0
1 0 1 FEMALE 1
ASCENDING ORDER ASCENDING ORDER
AGE (PMM-1)
VNo VL GVNo
0 0 0 1 0 0
1 1 1 3 1 2
ASCENDING ORDER ASCENDING ORDER
SORT BY AGE
GOrd OrdSet
0 - 0
→ 1 - 1
SORT BY SEX
GOrd OrdSet
0 - 1
→ 1 - 0
OFFSET= 5
PMM-2
SEX AGE HEIGHT
0 FEMALE 1 76
1 FEMALE 1 78
2 FEMALE 2 84
GOrd OrdSet
0 5 0
1 6 1
2 7 2
ASCENDING ORDER
SEX (PMM-2)
VNo VL GVNo
0 0 0 FEMALE 0
1 0 ASCENDING ORDER ASCENDING ORDER
2 0 1
AGE (PMM-2)
VNo VL GVNo
0 0 0 1 0 0
1 0 1 2 1 1
2 1 ASCENDING ORDER ASCENDING ORDER
SORT BY AGE
GOrd OrdSet
0 - 0
→ 1 - 1
2 - 2
SORT BY SEX
GOrd OrdSet
0 - 0
→ 1 - 1
2 - 2
OFFSET= 8
PMM-3
SEX AGE HEIGHT
0 MALE 3 87
1 FEMALE 3 80
GOrd OrdSet
0 8 0
1 9 1
ASCENDING ORDER
SEX (PMM-3)
VNo VL GVNo
0 0 0 MALE 0
1 1 1 FEMALE 1
ASCENDING ORDER ASCENDING ORDER
AGE (PMM-3)
VNo VL GVNo
0 0 0 3 0 2
1 0 ASCENDING ORDER ASCENDING ORDER
SORT BY AGE
GOrd OrdSet
0 - 0
→ 1 - 1
SORT BY SEX
GOrd OrdSet
0 - 0
→ 1 - 1

Fig.10

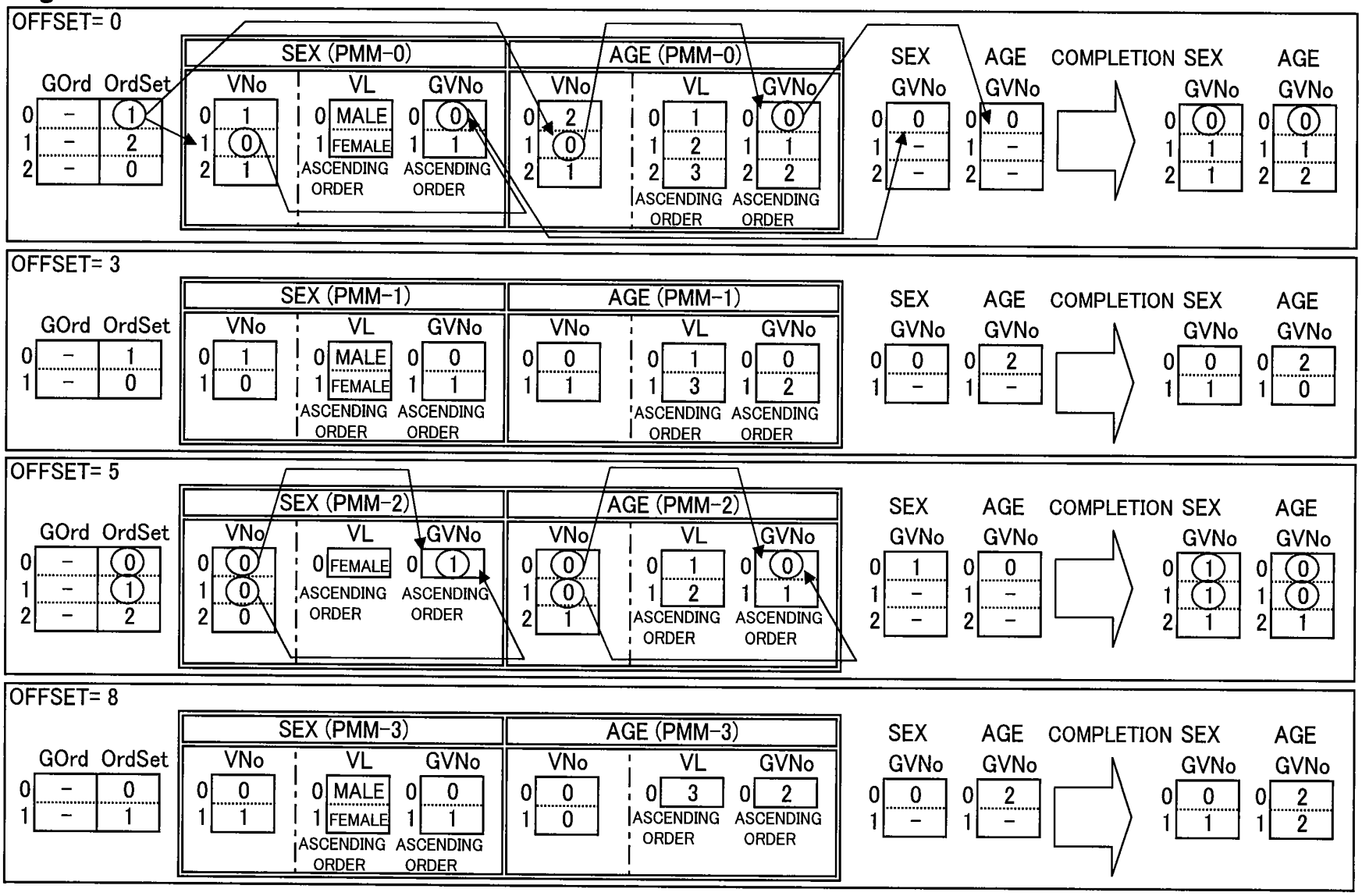
OFFSET= 0
GOrd OrdSet
SEX (PMM-0)
AGE (PMM-0)
VNo VL GVNo
MALE
FEMALE
ASCENDING ORDER
SEX GVNo
AGE GVNo
COMPLETION SEX GVNo
AGE GVNo
OFFSET= 3
SEX (PMM-1)
AGE (PMM-1)
OFFSET= 5
SEX (PMM-2)
AGE (PMM-2)
OFFSET= 8
SEX (PMM-3)
AGE (PMM-3)

Fig.11

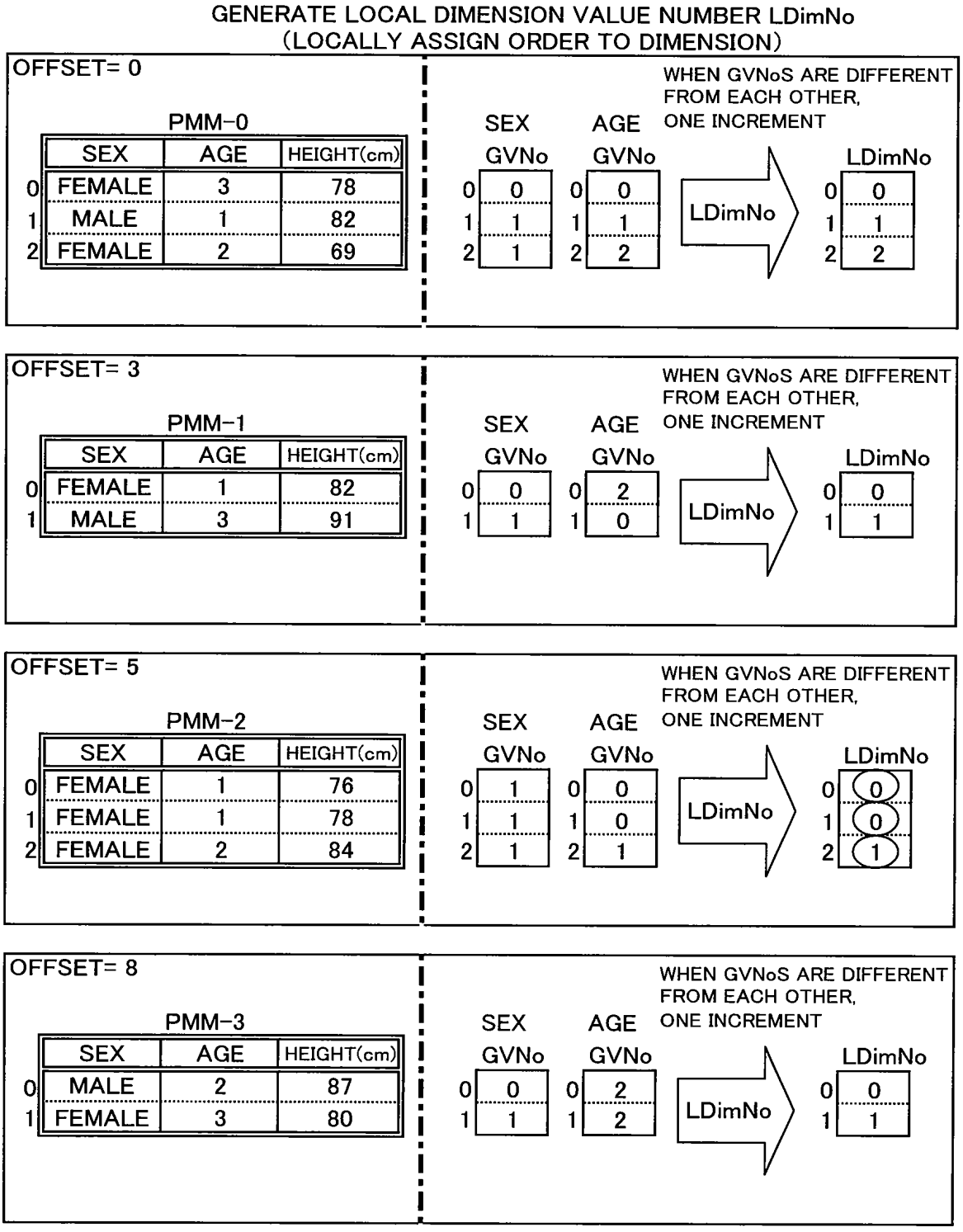
GENERATE LOCAL DIMENSION VALUE NUMBER LDimNo
(LOCALLY ASSIGN ORDER TO DIMENSION)
OFFSET= 0
PMM-0
SEX AGE HEIGHT(cm)
0 FEMALE 3 78
1 MALE 1 82
2 FEMALE 2 69
WHEN GVNoS ARE DIFFERENT FROM EACH OTHER, ONE INCREMENT
SEX GVNo
AGE GVNo
LDimNo
OFFSET= 3
PMM-1
SEX AGE HEIGHT(cm)
0 FEMALE 1 82
1 MALE 3 91
OFFSET= 5
PMM-2
SEX AGE HEIGHT(cm)
0 FEMALE 1 76
1 FEMALE 1 78
2 FEMALE 2 84
OFFSET= 8
PMM-3
SEX AGE HEIGHT(cm)
0 MALE 2 87
1 FEMALE 3 80

Fig.12

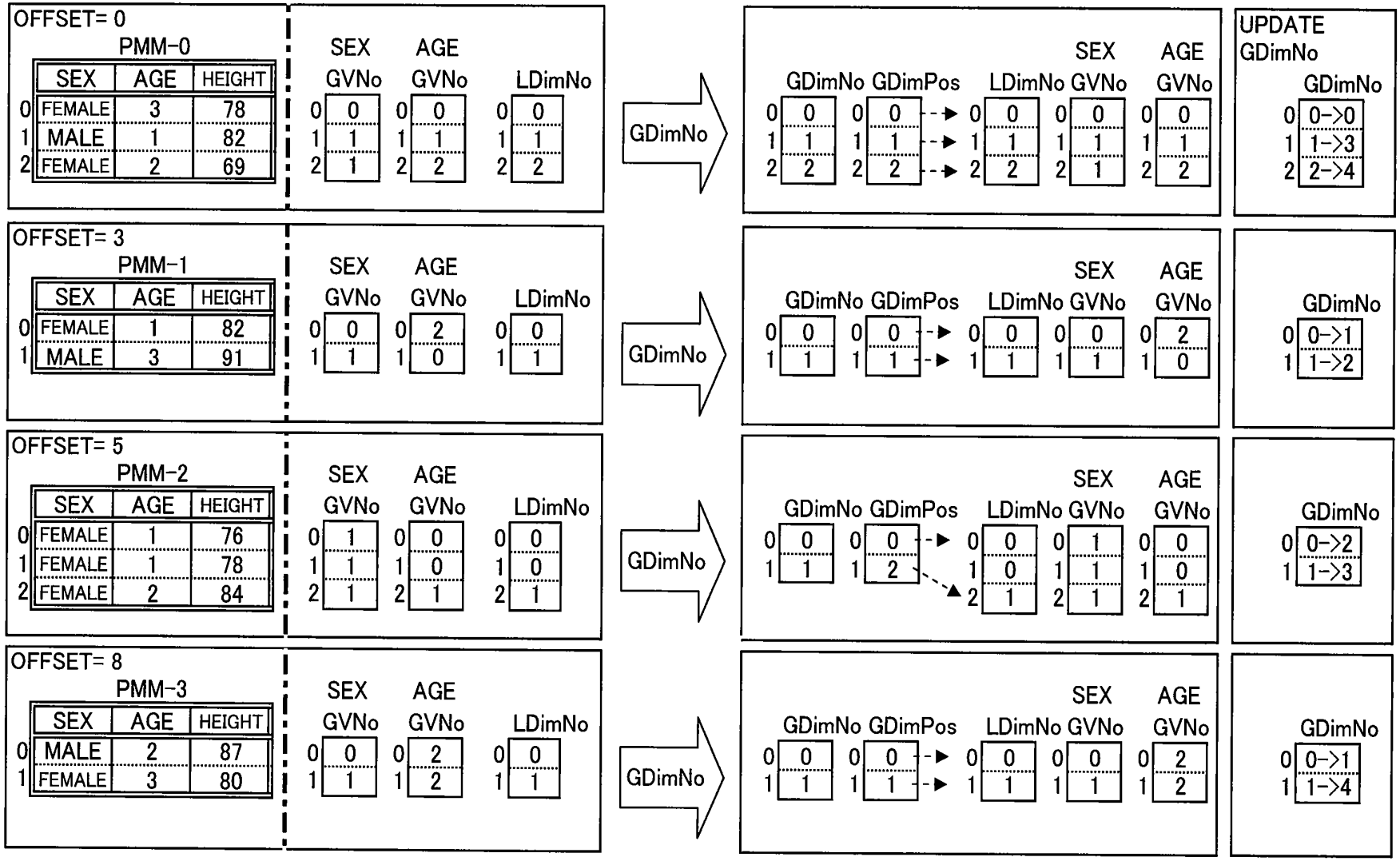
OFFSET= 0
PMM-0
SEX | AGE | HEIGHT
0 FEMALE | 3 | 78
1 MALE | 1 | 82
2 FEMALE | 2 | 69
SEX GVNo
AGE GVNo
LDimNo
GDimNo
GDimNo GDimPos
LDimNo
SEX GVNo
AGE GVNo
UPDATE GDimNo
0->0
1->3
2->4
OFFSET= 3
PMM-1
SEX | AGE | HEIGHT
0 FEMALE | 1 | 82
1 MALE | 3 | 91
0->1
1->2
OFFSET= 5
PMM-2
SEX | AGE | HEIGHT
0 FEMALE | 1 | 76
1 FEMALE | 1 | 78
2 FEMALE | 2 | 84
0->2
1->3
OFFSET= 8
PMM-3
SEX | AGE | HEIGHT
0 MALE | 2 | 87
1 FEMALE | 3 | 80
0->1
1->4

Fig.13

	LDimNo	GNo1	GNo2	GDimNo
PMM-0	0	0	0	0
	1	1	1	3
	2	1	2	4
PMM-1	0	0	2	1
	1	1	0	2
PMM-2	0	1	0	2
	1	1	1	3
PMM-3	0	0	2	1
	1	1	1	2

Fig.14

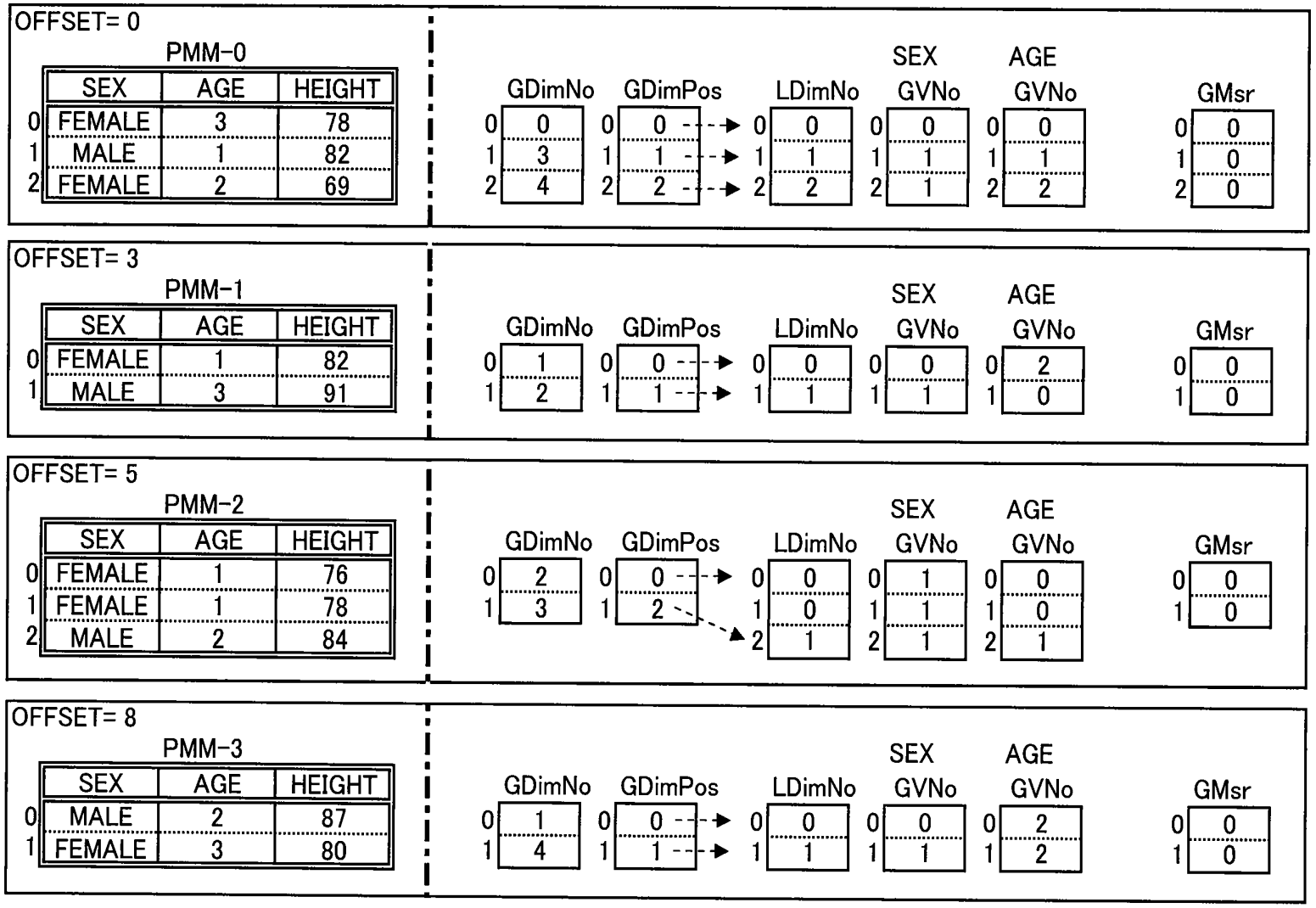
OFFSET= 0
PMM-0
SEX AGE HEIGHT
0 FEMALE 3 78
1 MALE 1 82
2 FEMALE 2 69
GDimNo GDimPos LDimNo SEX GVNo AGE GVNo GMsr
OFFSET= 3
PMM-1
SEX AGE HEIGHT
0 FEMALE 1 82
1 MALE 3 91
GDimNo GDimPos LDimNo SEX GVNo AGE GVNo GMsr
OFFSET= 5
PMM-2
SEX AGE HEIGHT
0 FEMALE 1 76
1 FEMALE 1 78
2 MALE 2 84
GDimNo GDimPos LDimNo SEX GVNo AGE GVNo GMsr
OFFSET= 8
PMM-3
SEX AGE HEIGHT
0 MALE 2 87
1 FEMALE 3 80
GDimNo GDimPos LDimNo SEX GVNo AGE GVNo GMsr

Fig.15

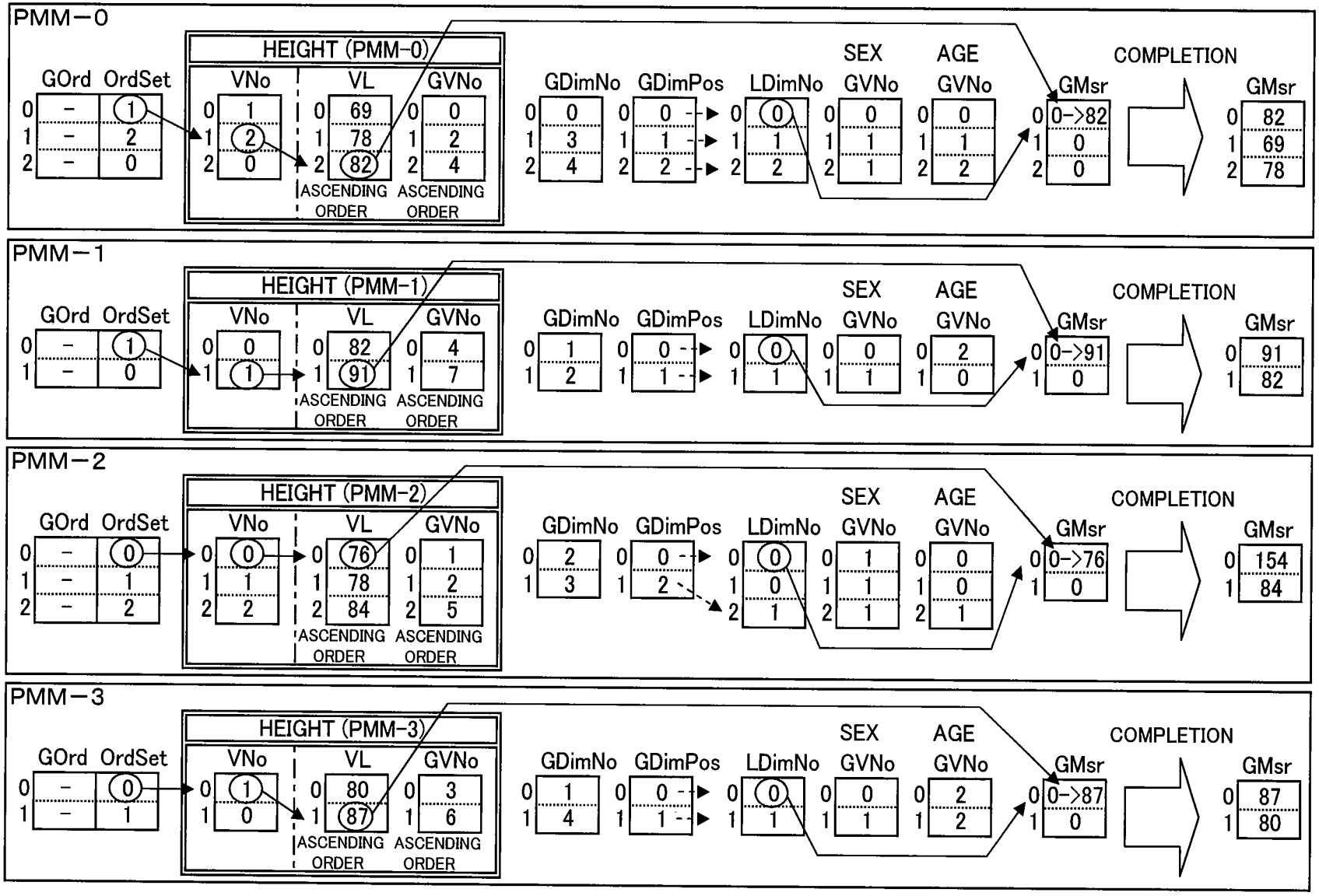
PMM−0
HEIGHT (PMM-0)
GOrd OrdSet
VNo VL GVNo
ASCENDING ORDER
ASCENDING ORDER
GDimNo GDimPos LDimNo
SEX GVNo
AGE GVNo
GMsr
COMPLETION
0->82
PMM−1
HEIGHT (PMM-1)
0->91
PMM−2
HEIGHT (PMM-2)
0->76
PMM−3
HEIGHT (PMM-3)
0->87

Fig.16

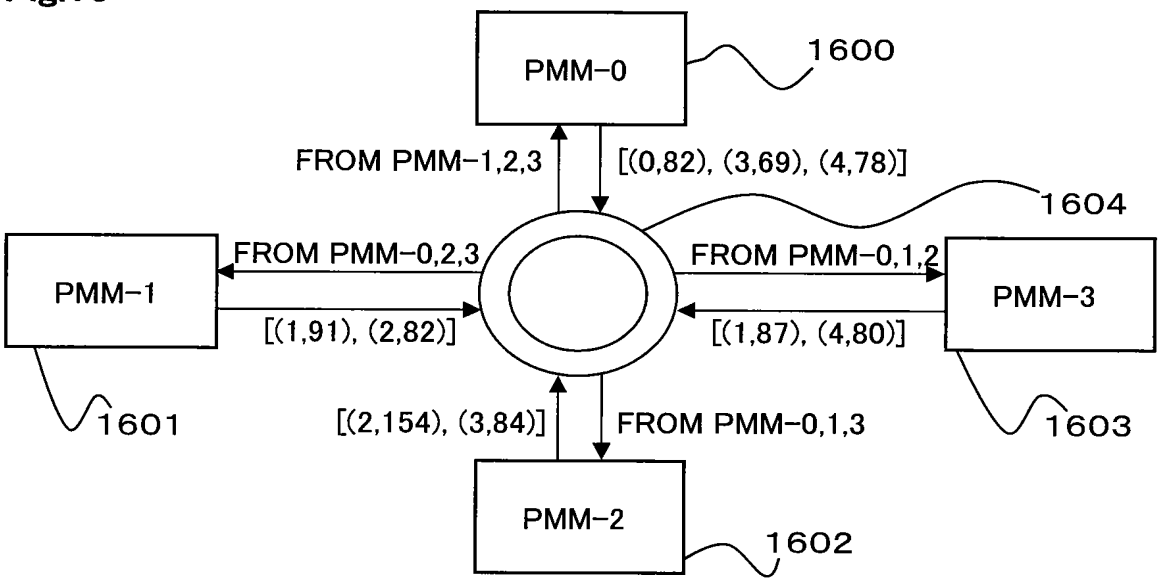
PMM-0
1600
FROM PMM-1,2,3
[(0,82), (3,69), (4,78)]
1604
PMM-1
FROM PMM-0,2,3
FROM PMM-0,1,2
PMM-3
[(1,91), (2,82)]
[(1,87), (4,80)]
1601
[(2,154), (3,84)]
FROM PMM-0,1,3
1603
PMM-2
1602

Fig.17

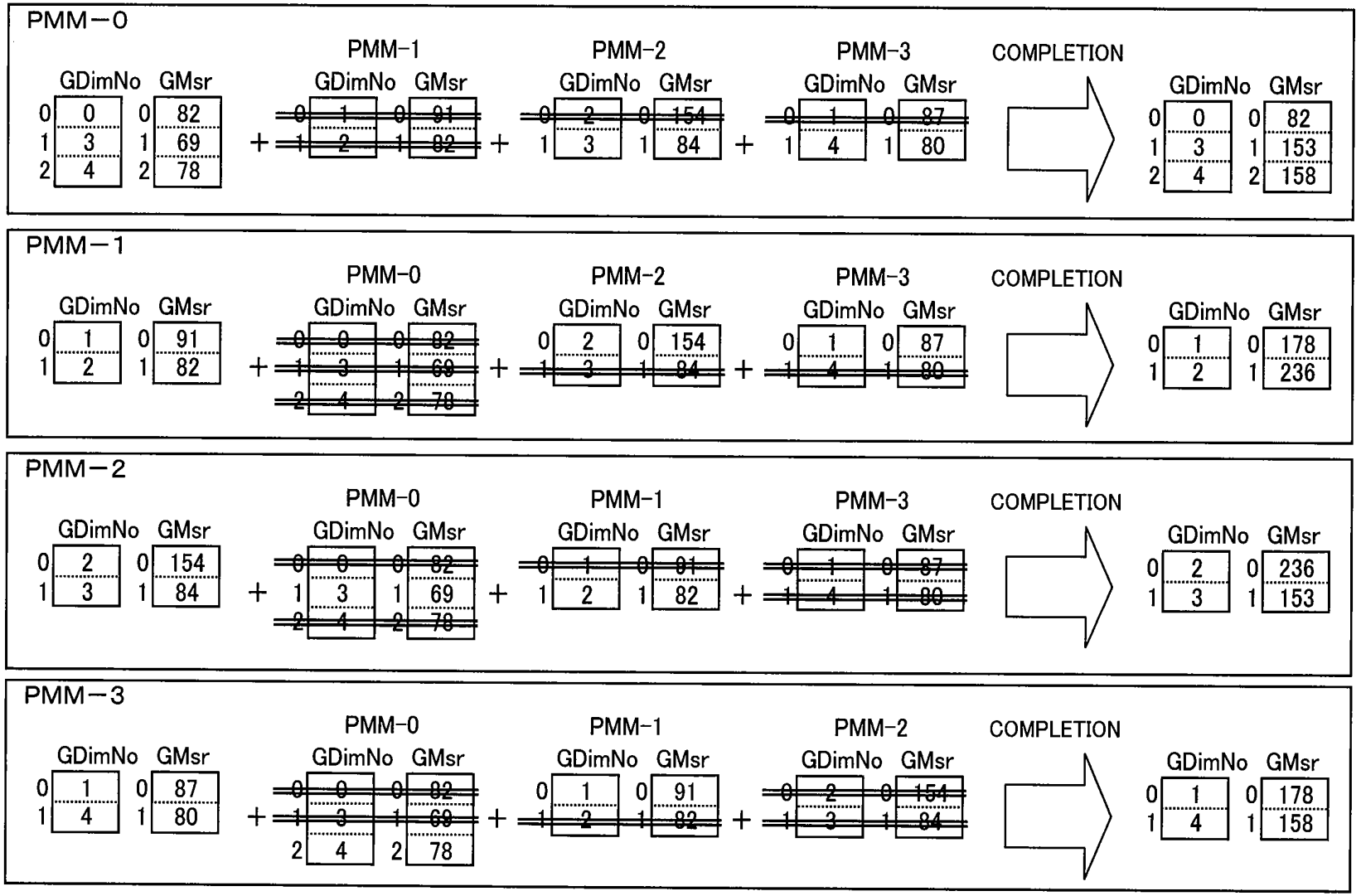
PMM−0
PMM-1
PMM-2
PMM-3
COMPLETION
GDimNo GMsr
0 0 0 82
1 3 1 69
2 4 2 78
1 2 1 82
2 3 1 84
1 4 1 80
0 1 0 91
0 2 0 154
0 1 0 87
0 0 0 82
1 3 1 69
2 4 2 78
0 1 0 178
1 2 1 236
0 2 0 236
1 3 1 153
0 1 0 178
1 4 1 158
PMM−1
PMM-0
PMM-2
PMM-3
PMM−2
PMM-0
PMM-1
PMM-3
PMM−3
PMM-0
PMM-1
PMM-2

Fig.18

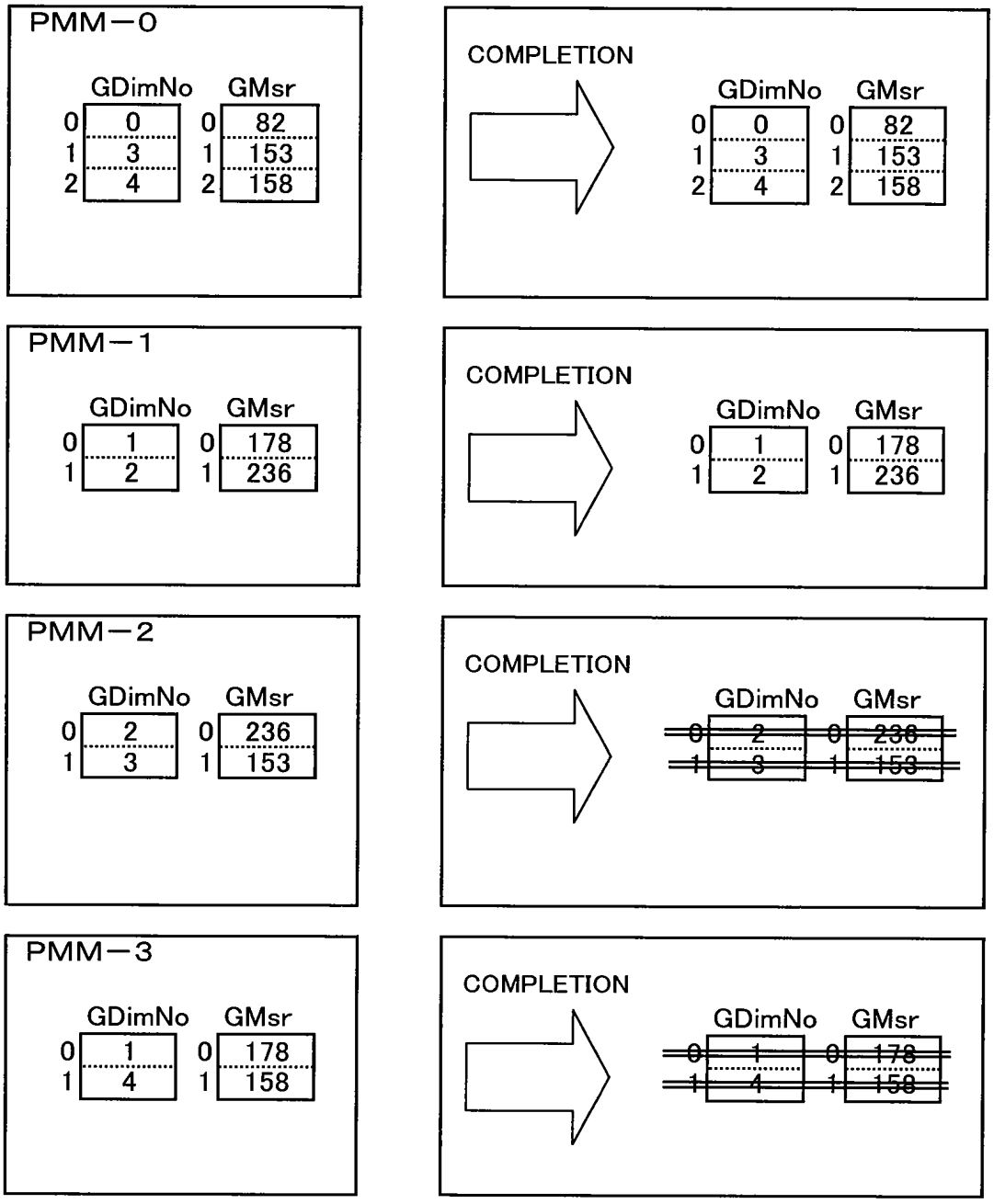
PMM−0
GDimNo
GMsr
0 0
1 3
2 4
0 82
1 153
2 158
COMPLETION
GDimNo
GMsr
0 0
1 3
2 4
0 82
1 153
2 158
PMM−1
GDimNo
GMsr
0 1
1 2
0 178
1 236
COMPLETION
GDimNo
GMsr
0 1
1 2
0 178
1 236
PMM−2
GDimNo
GMsr
0 2
1 3
0 236
1 153
COMPLETION
GDimNo
GMsr
0 2
1 3
0 236
1 153
PMM−3
GDimNo
GMsr
0 1
1 4
0 178
1 158
COMPLETION
GDimNo
GMsr
0 1
1 4
0 178
1 158

Fig.19

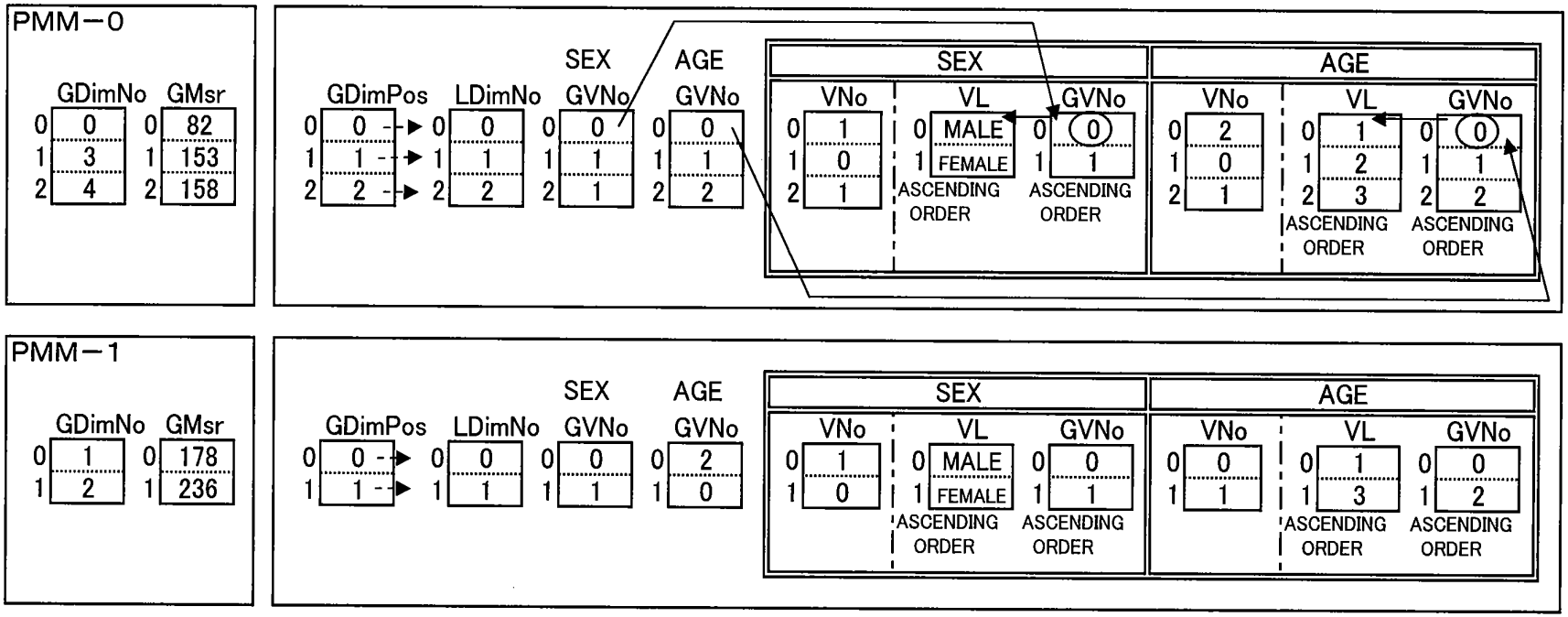
PMM−0
GDimNo
GMsr
0 0
1 3
2 4
0 82
1 153
2 158
GDimPos
LDimNo
SEX
GVNo
AGE
GVNo
SEX
VNo
VL
GVNo
AGE
VNo
VL
GVNo
MALE
FEMALE
ASCENDING ORDER
PMM−1
GDimNo
GMsr
0 1
1 2
0 178
1 236
GDimPos
LDimNo
SEX
GVNo
AGE
GVNo
SEX
VNo
VL
GVNo
AGE
VNo
VL
GVNo
MALE
FEMALE
ASCENDING ORDER

Fig.20

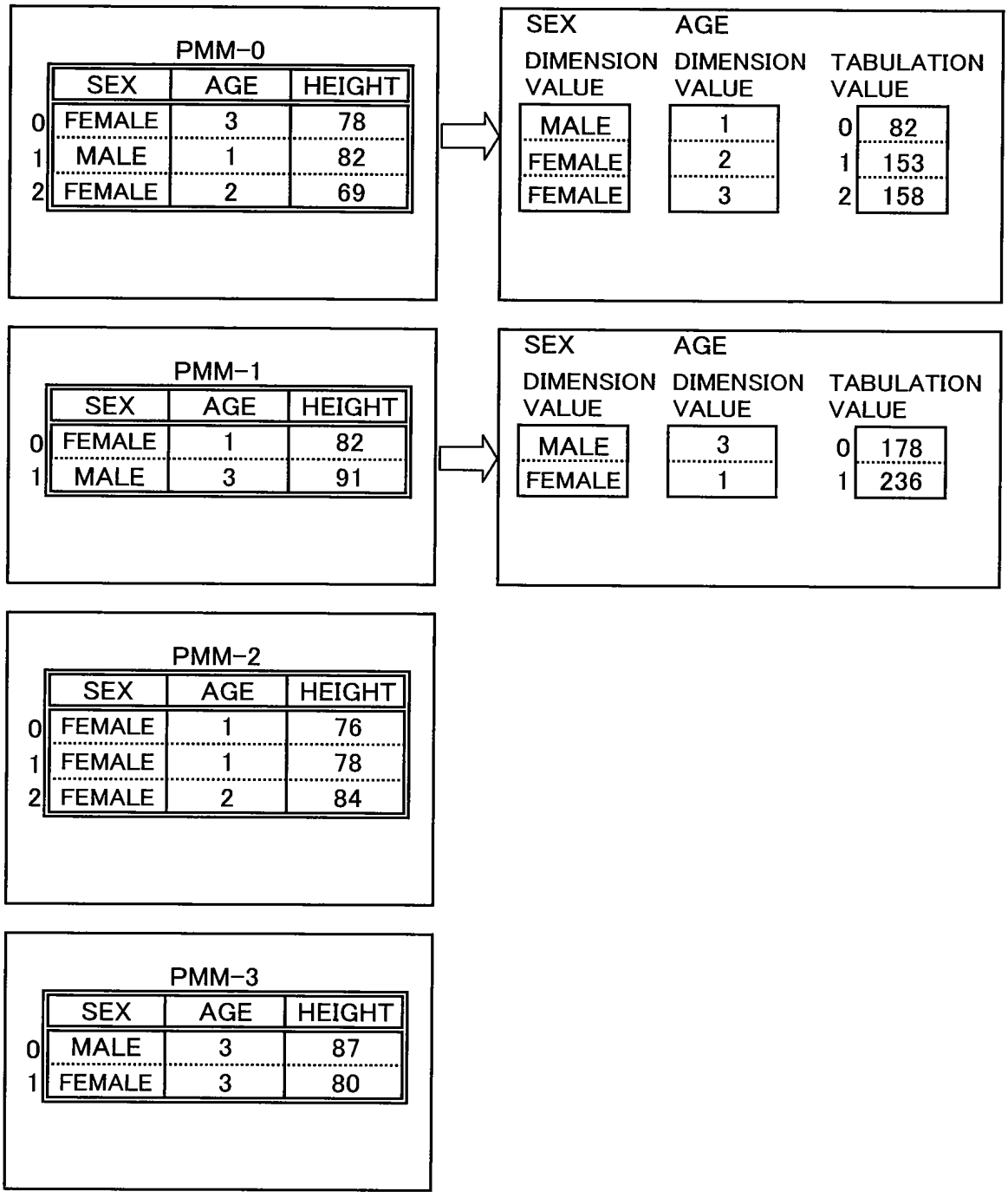
PMM-0
SEX
AGE
HEIGHT
0 FEMALE 3 78
1 MALE 1 82
2 FEMALE 2 69
SEX
AGE
DIMENSION VALUE
DIMENSION VALUE
TABULATION VALUE
MALE
FEMALE
FEMALE
1
2
3
0 82
1 153
2 158
PMM-1
SEX
AGE
HEIGHT
0 FEMALE 1 82
1 MALE 3 91
SEX
AGE
DIMENSION VALUE
DIMENSION VALUE
TABULATION VALUE
MALE
FEMALE
3
1
0 178
1 236
PMM-2
SEX
AGE
HEIGHT
0 FEMALE 1 76
1 FEMALE 1 78
2 FEMALE 2 84
PMM-3
SEX
AGE
HEIGHT
0 MALE 3 87
1 FEMALE 3 80

Fig.21

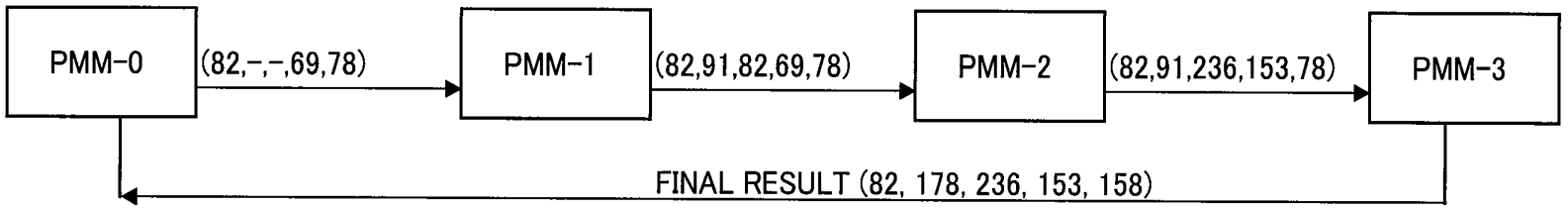
PMM-0
(82,-,-,69,78)
PMM-1
(82,91,82,69,78)
PMM-2
(82,91,236,153,78)
PMM-3
FINAL RESULT (82, 178, 236, 153, 158)

Fig.22

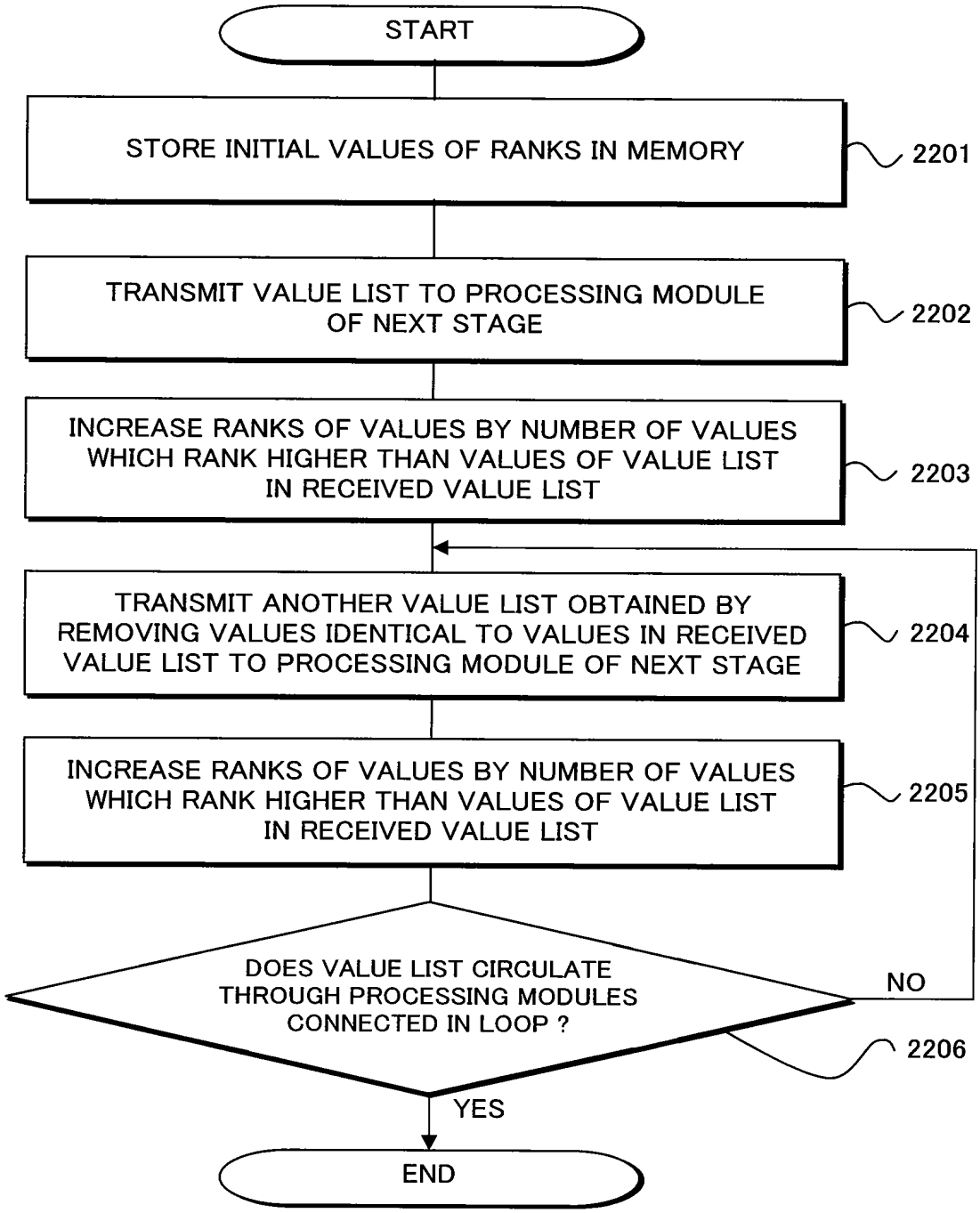
START
STORE INITIAL VALUES OF RANKS IN MEMORY
2201
TRANSMIT VALUE LIST TO PROCESSING MODULE OF NEXT STAGE
2202
INCREASE RANKS OF VALUES BY NUMBER OF VALUES WHICH RANK HIGHER THAN VALUES OF VALUE LIST IN RECEIVED VALUE LIST
2203
TRANSMIT ANOTHER VALUE LIST OBTAINED BY REMOVING VALUES IDENTICAL TO VALUES IN RECEIVED VALUE LIST TO PROCESSING MODULE OF NEXT STAGE
2204
INCREASE RANKS OF VALUES BY NUMBER OF VALUES WHICH RANK HIGHER THAN VALUES OF VALUE LIST IN RECEIVED VALUE LIST
2205
DOES VALUE LIST CIRCULATE THROUGH PROCESSING MODULES CONNECTED IN LOOP ?
NO
2206
YES
END

Fig.23A

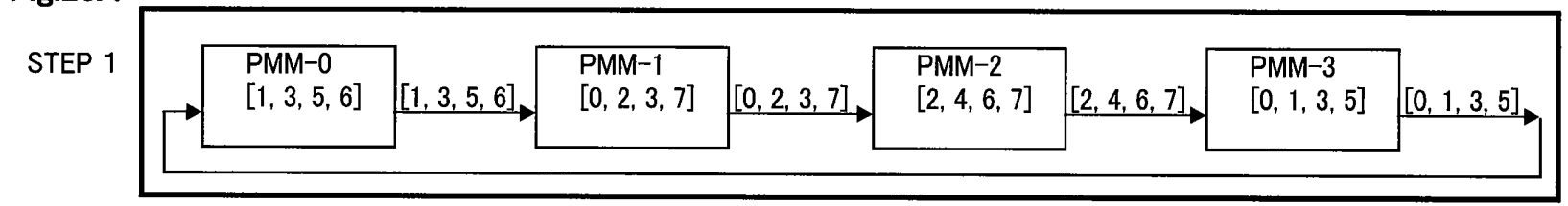

Fig.23B

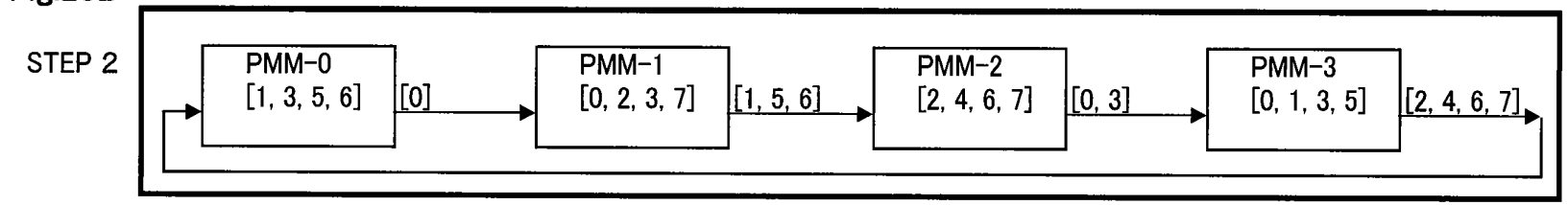

Fig.23C

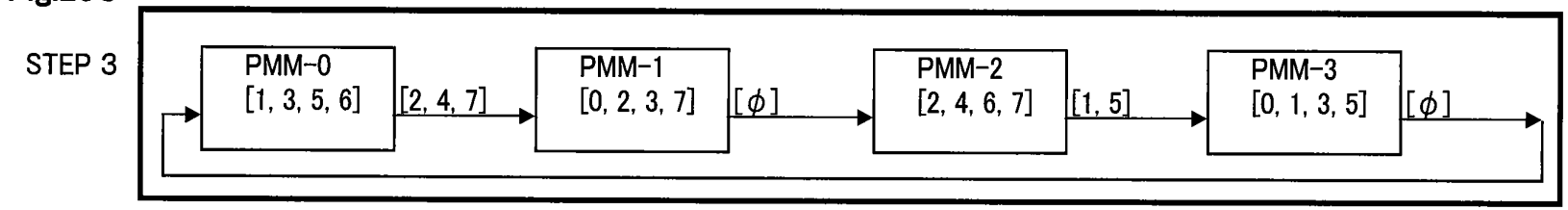

Fig.23D

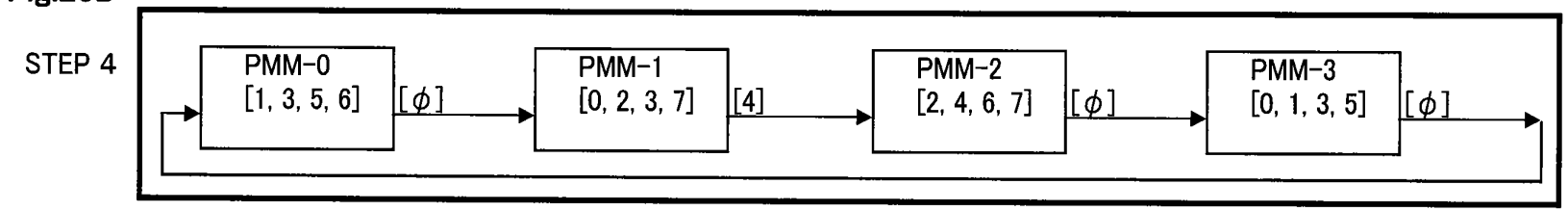

Fig.24A

STEP 1

RECEPTION LIST			
PMM-0	PMM-1	PMM-2	PMM-3
[0, 1, 3, 5]	[1, 3, 5, 6]	[0, 2, 3, 7]	[2, 4, 6, 7]

Fig.24B

STEP 2

RECEPTION LIST			
PMM-0	PMM-1	PMM-2	PMM-3
[0, 1, 3, 5]	[1, 3, 5, 6]	[0, 2, 3, 7]	[2, 4, 6, 7]
[2, 4, 6, 7]	[0]	[1, 5, 6]	[0, 3]

Fig.24C

STEP 3

RECEPTION LIST			
PMM-0	PMM-1	PMM-2	PMM-3
[0, 1, 3, 5]	[1, 3, 5, 6]	[0, 2, 3, 7]	[2, 4, 6, 7]
[2, 4, 6, 7]	[0]	[1, 5, 6]	[0, 3]
[ϕ]	[2, 4, 7]	[ϕ]	[1, 5]

Fig.24D

STEP 4

RECEPTION LIST			
PMM-0	PMM-1	PMM-2	PMM-3
[0, 1, 3, 5]	[1, 3, 5, 6]	[0, 2, 3, 7]	[2, 4, 6, 7]
[2, 4, 6, 7]	[0]	[1, 5, 6]	[0, 3]
[ϕ]	[2, 4, 7]	[ϕ]	[1, 5]
[ϕ]	[ϕ]	[4]	[ϕ]

Fig.25

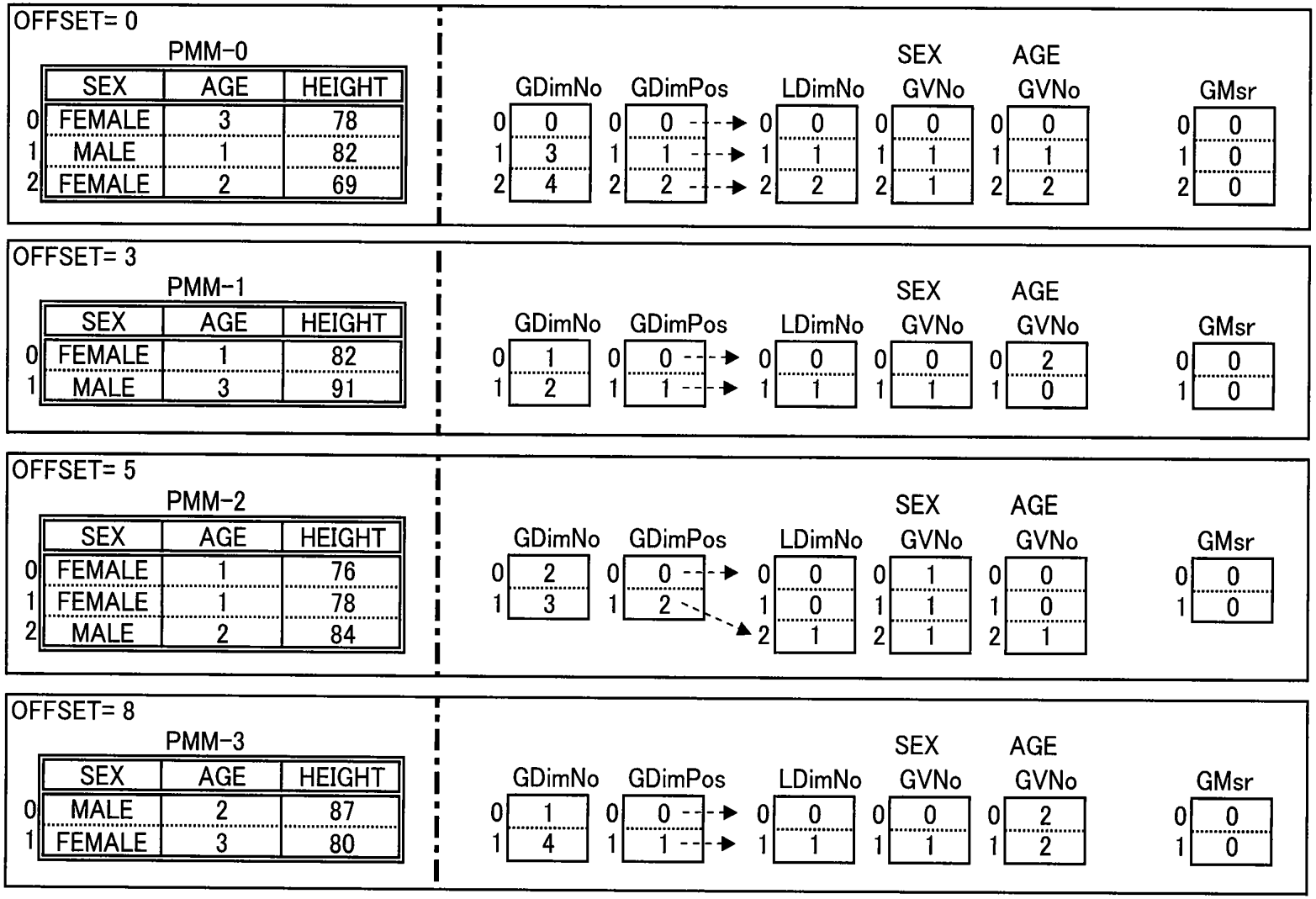
OFFSET= 0
PMM-0
SEX AGE HEIGHT
0 FEMALE 3 78
1 MALE 1 82
2 FEMALE 2 69
GDimNo GDimPos LDimNo SEX GVNo AGE GVNo GMsr
0 0 0 0 0 0 0 0 0 0
1 3 1 1 1 1 1 1 1 0
2 4 2 2 2 2 2 1 2 0
OFFSET= 3
PMM-1
SEX AGE HEIGHT
0 FEMALE 1 82
1 MALE 3 91
GDimNo GDimPos LDimNo SEX GVNo AGE GVNo GMsr
0 1 0 0 0 0 0 0 0 2 0 0
1 2 1 1 1 1 1 1 1 0 1 0
OFFSET= 5
PMM-2
SEX AGE HEIGHT
0 FEMALE 1 76
1 FEMALE 1 78
2 MALE 2 84
GDimNo GDimPos LDimNo SEX GVNo AGE GVNo GMsr
0 2 0 0 0 0 0 1 0 0 0 0
1 3 1 2 1 0 1 1 1 0 1 0
2 1 2 1 2 1
OFFSET= 8
PMM-3
SEX AGE HEIGHT
0 MALE 2 87
1 FEMALE 3 80
GDimNo GDimPos LDimNo SEX GVNo AGE GVNo GMsr
0 1 0 0 0 0 0 0 0 2 0 0
1 4 1 1 1 1 1 1 1 2 1 0

Fig.26

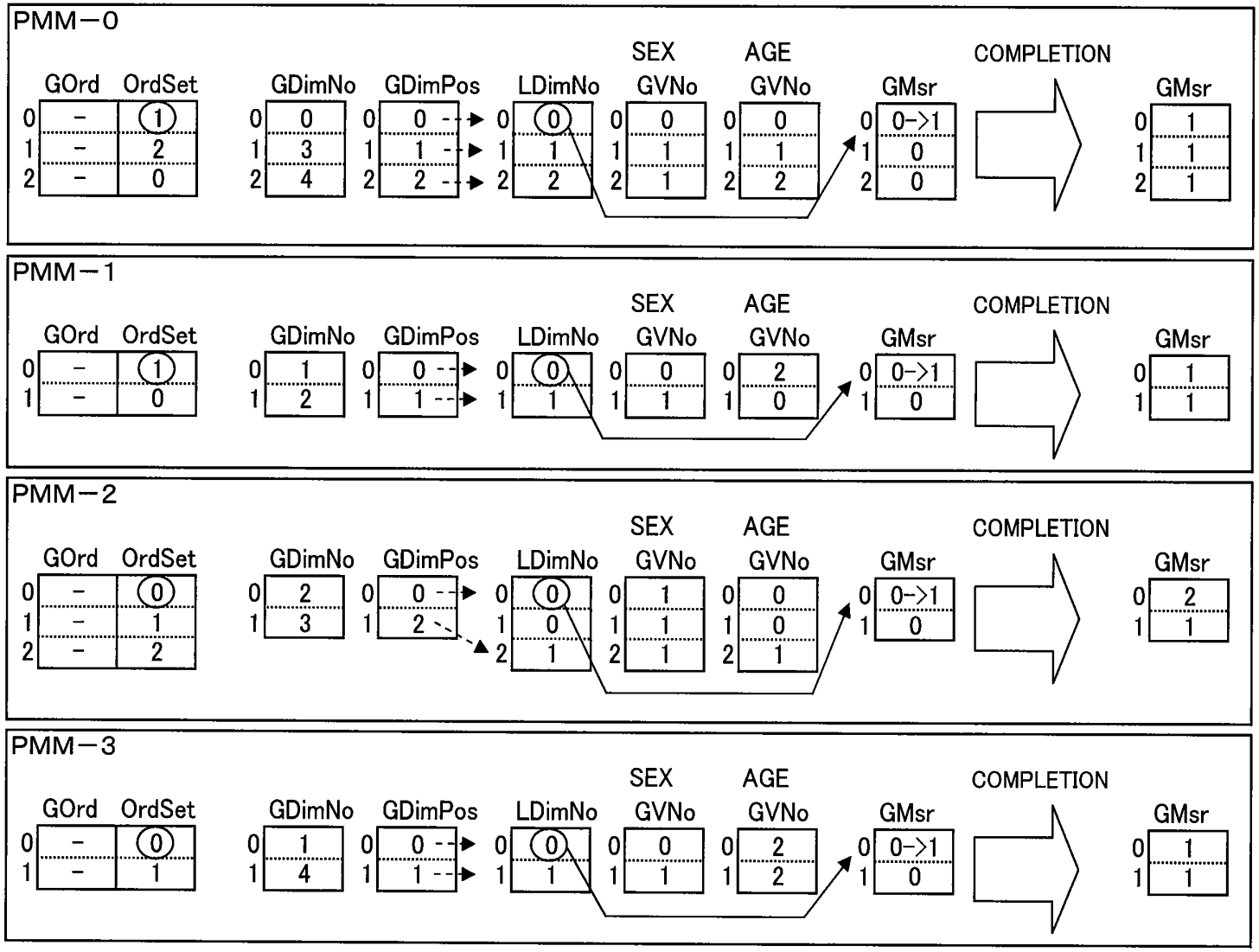
PMM−0
GOrd
OrdSet
GDimNo
GDimPos
LDimNo
SEX
GVNo
AGE
GVNo
GMsr
COMPLETION
GMsr
PMM−1
PMM−2
PMM−3

Fig.27

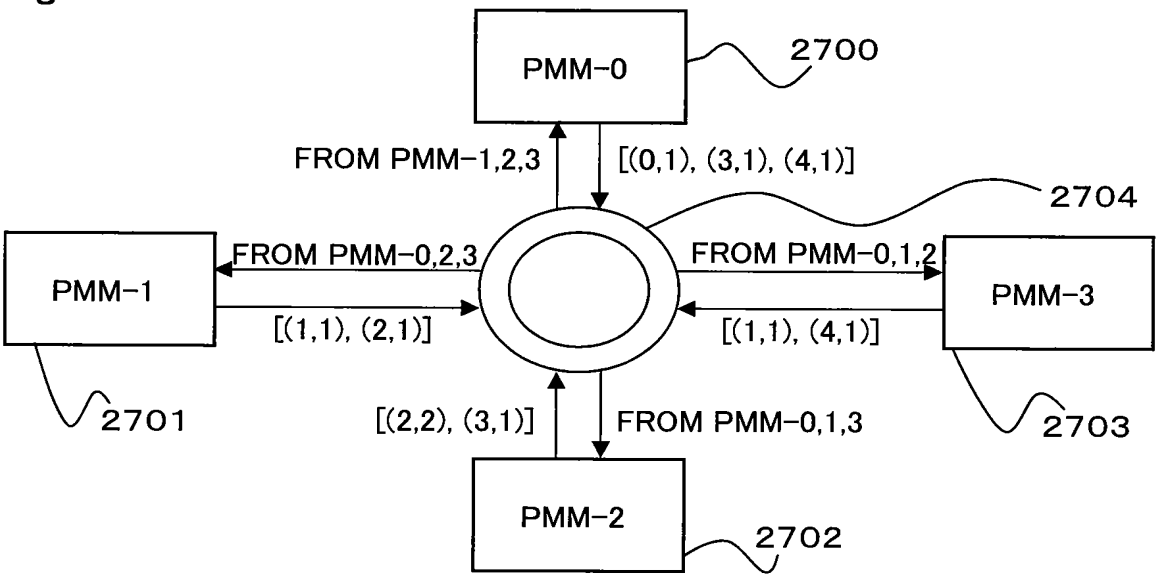
PMM-0
2700
FROM PMM-1,2,3
[(0,1), (3,1), (4,1)]
2704
PMM-1
FROM PMM-0,2,3
[(1,1), (2,1)]
FROM PMM-0,1,2
[(1,1), (4,1)]
PMM-3
2701
[(2,2), (3,1)]
FROM PMM-0,1,3
2703
PMM-2
2702

Fig.28

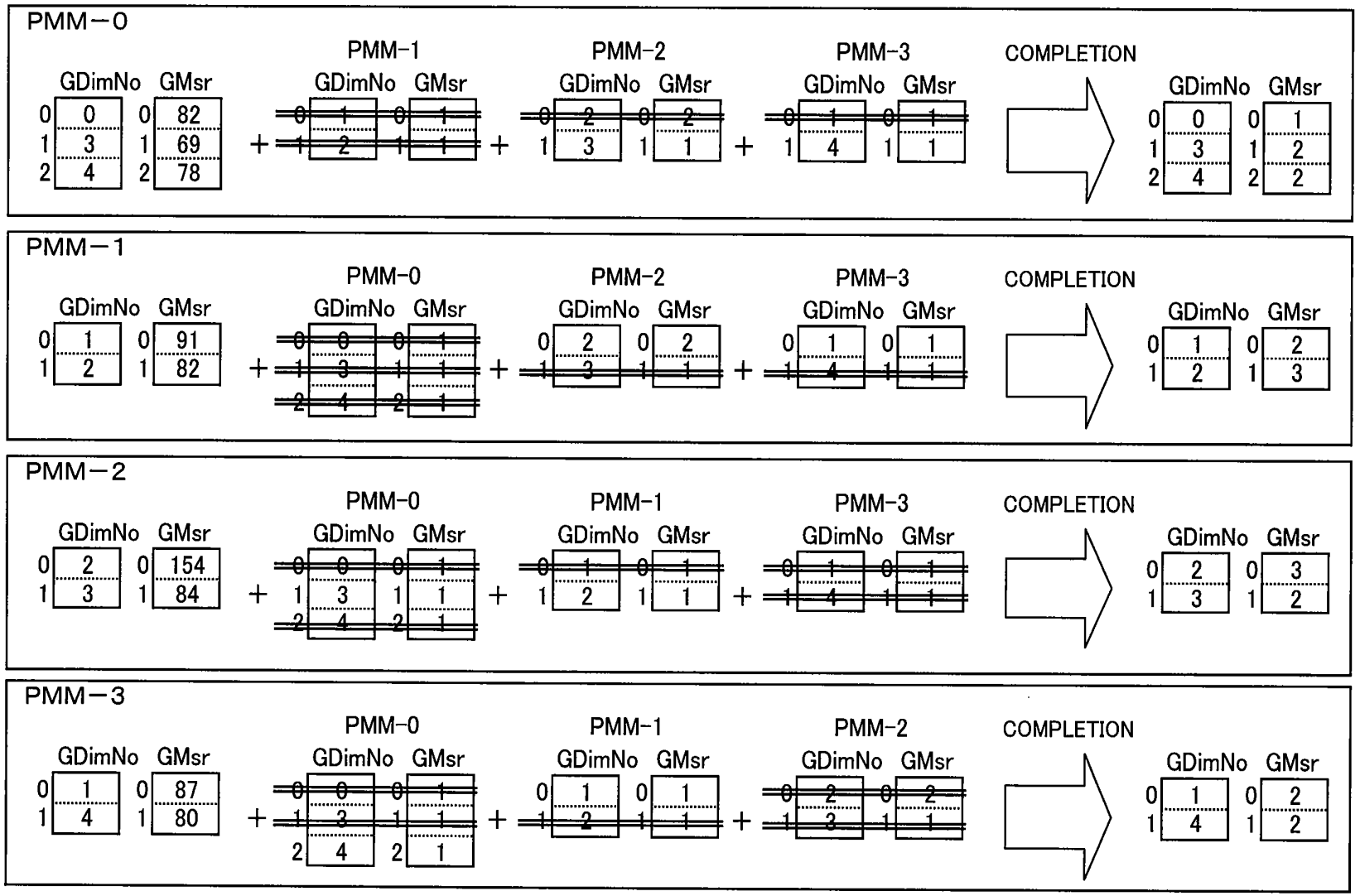
PMM−0
GDimNo GMsr
0 0 0 82
1 3 1 69
2 4 2 78
PMM-1
PMM-2
PMM-3
COMPLETION
GDimNo GMsr
0 0 0 1
1 3 1 2
2 4 2 2
PMM−1
GDimNo GMsr
0 1 0 91
1 2 1 82
PMM-0
PMM-2
PMM-3
COMPLETION
GDimNo GMsr
0 1 0 2
1 2 1 3
PMM−2
GDimNo GMsr
0 2 0 154
1 3 1 84
PMM-0
PMM-1
PMM-3
COMPLETION
GDimNo GMsr
0 2 0 3
1 3 1 2
PMM−3
GDimNo GMsr
0 1 0 87
1 4 1 80
PMM-0
PMM-1
PMM-2
COMPLETION
GDimNo GMsr
0 1 0 2
1 4 1 2

Fig.29

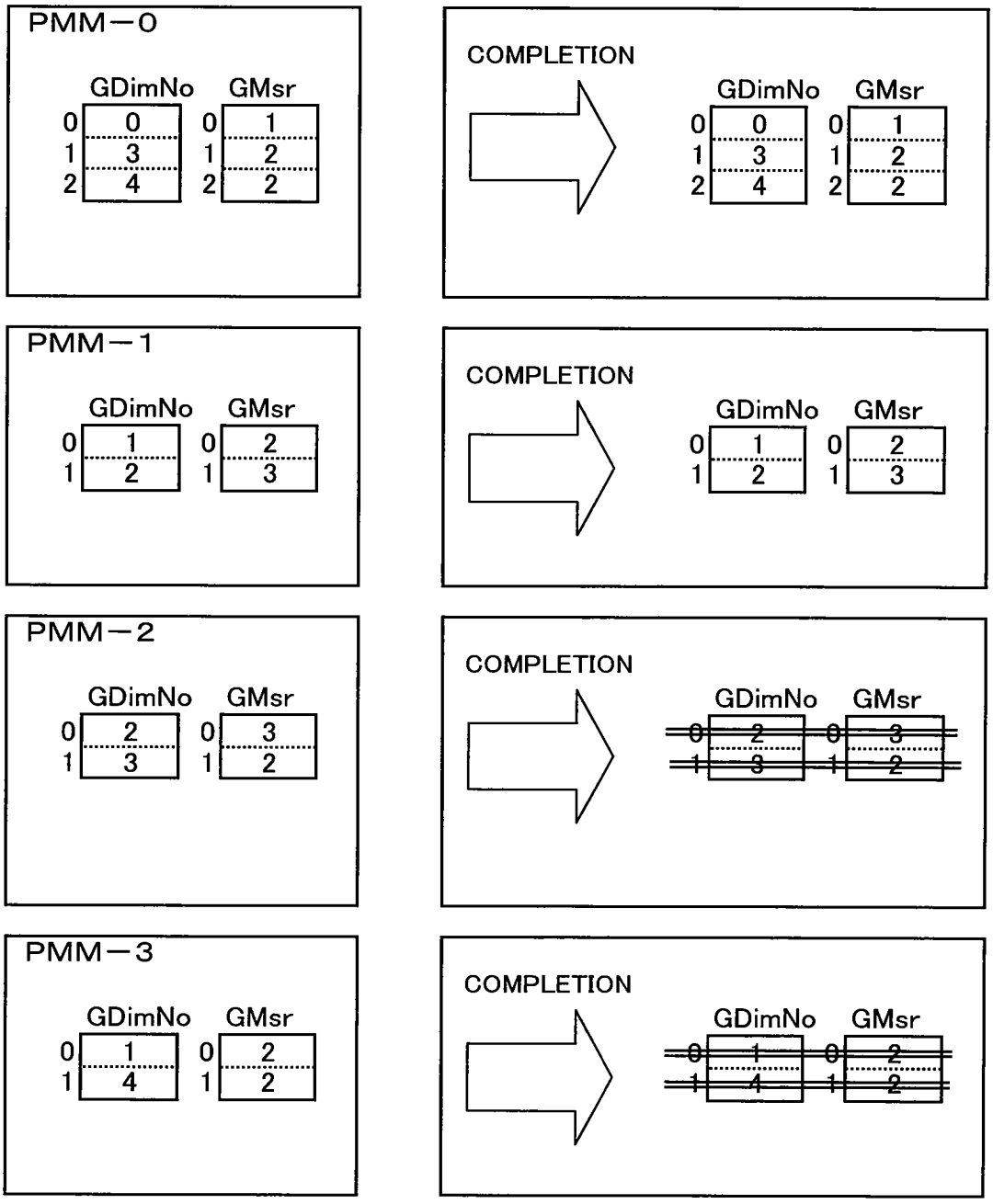
PMM−0
GDimNo
GMsr
0 0
1 3
2 4
0 1
1 2
2 2
COMPLETION
GDimNo
GMsr
0 0
1 3
2 4
0 1
1 2
2 2
PMM−1
GDimNo
GMsr
0 1
1 2
0 2
1 3
COMPLETION
GDimNo
GMsr
0 1
1 2
0 2
1 3
PMM−2
GDimNo
GMsr
0 2
1 3
0 3
1 2
COMPLETION
GDimNo
GMsr
0 2
1 3
0 3
1 2
PMM−3
GDimNo
GMsr
0 1
1 4
0 2
1 2
COMPLETION
GDimNo
GMsr
0 1
1 4
0 2
1 2

Fig.30

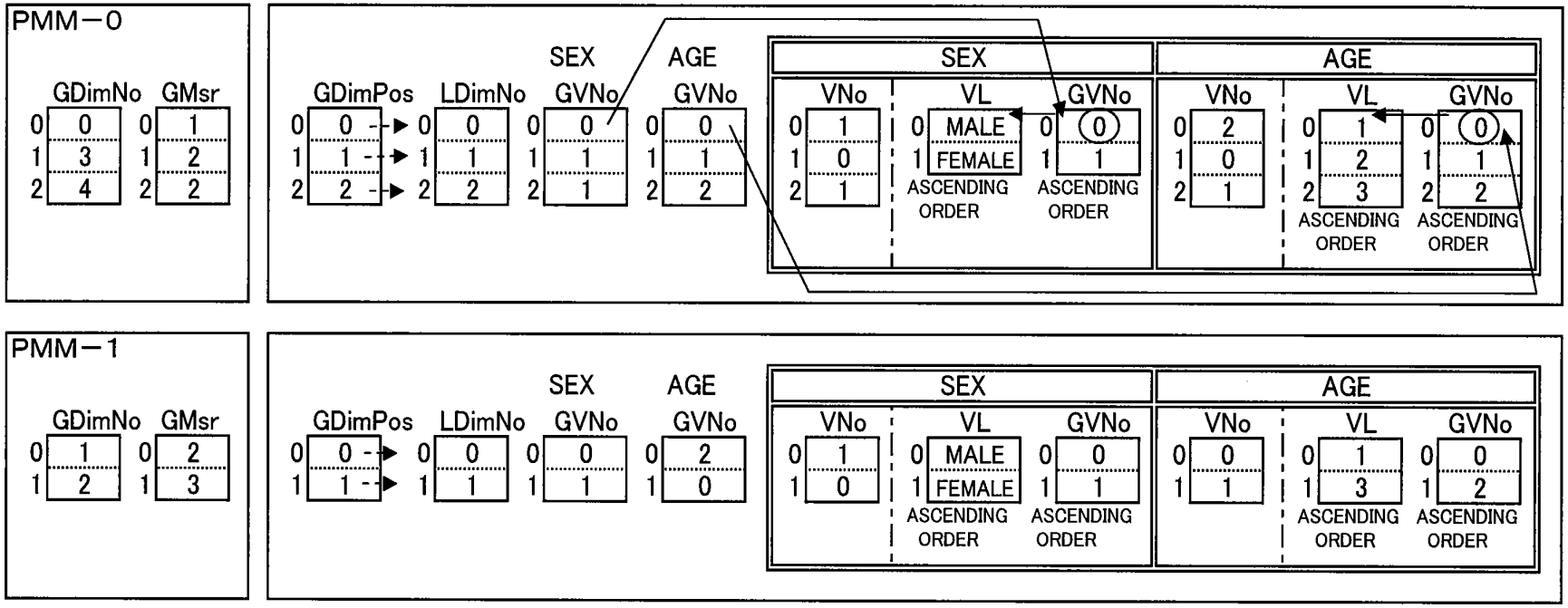
PMM−0
GDimNo
GMsr
0 0
1 3
2 4
0 1
1 2
2 2
GDimPos
LDimNo
SEX
GVNo
AGE
GVNo
0 0
1 1
2 2
0 0
1 1
2 2
0 0
1 1
2 1
0 0
1 1
2 2
SEX
AGE
VNo
VL
GVNo
0 1
1 0
2 1
0 MALE
1 FEMALE
ASCENDING ORDER
0 0
1 1
ASCENDING ORDER
0 2
1 0
2 1
0 1
1 2
2 3
ASCENDING ORDER
0 0
1 1
2 2
ASCENDING ORDER
PMM−1
GDimNo
GMsr
0 1
1 2
0 2
1 3
GDimPos
LDimNo
SEX
GVNo
AGE
GVNo
0 0
1 1
0 0
1 1
0 0
1 1
0 2
1 0
SEX
AGE
VNo
VL
GVNo
0 1
1 0
0 MALE
1 FEMALE
ASCENDING ORDER
0 0
1 1
ASCENDING ORDER
0 0
1 1
0 1
1 3
ASCENDING ORDER
0 0
1 2
ASCENDING ORDER

Fig.31

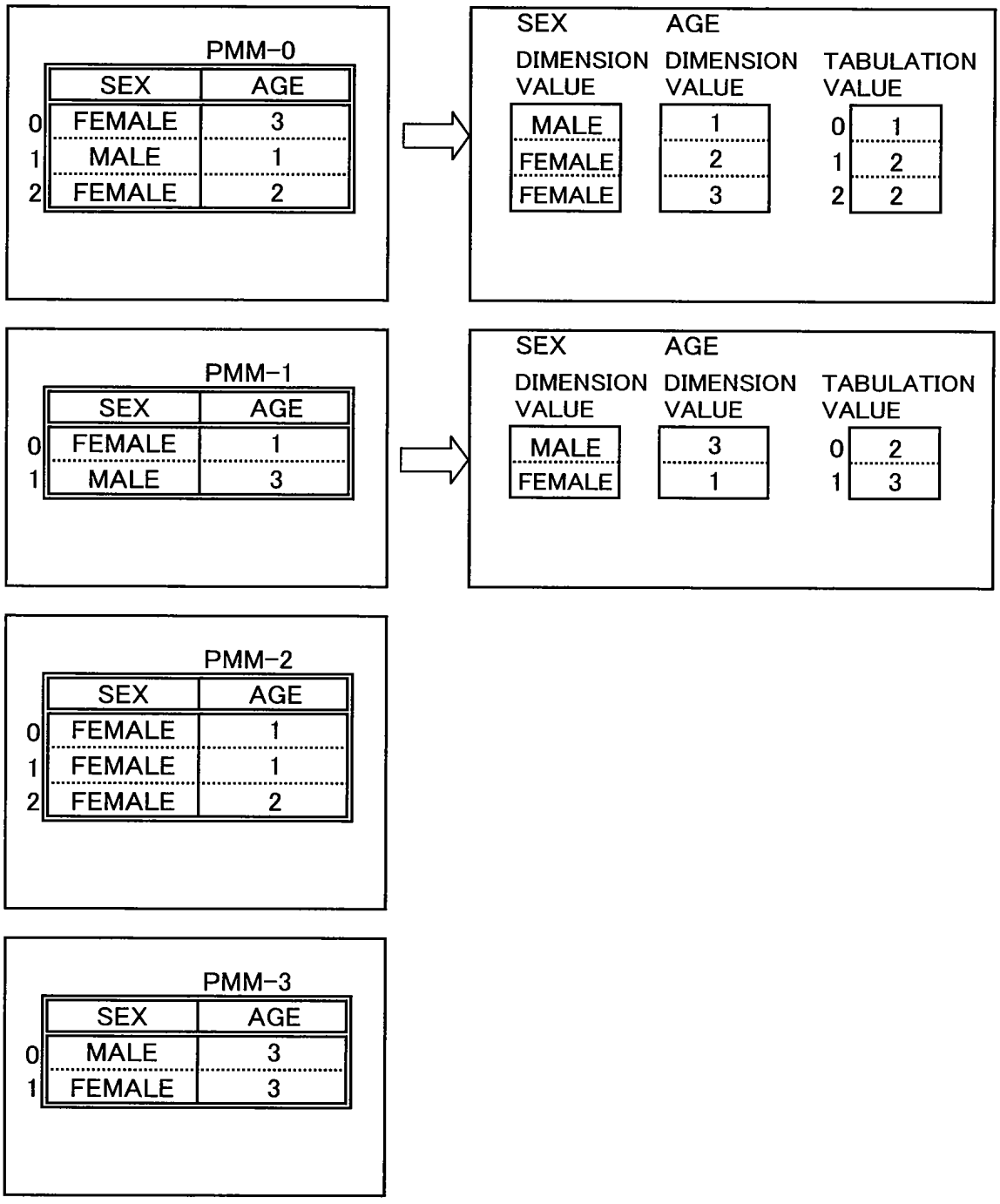
PMM-0
SEX
AGE
0 FEMALE 3
1 MALE 1
2 FEMALE 2
SEX
AGE
DIMENSION VALUE
DIMENSION VALUE
TABULATION VALUE
MALE
FEMALE
FEMALE
1
2
3
0 1
1 2
2 2
PMM-1
SEX
AGE
0 FEMALE 1
1 MALE 3
SEX
AGE
DIMENSION VALUE
DIMENSION VALUE
TABULATION VALUE
MALE
FEMALE
3
1
0 2
1 3
PMM-2
SEX
AGE
0 FEMALE 1
1 FEMALE 1
2 FEMALE 2
PMM-3
SEX
AGE
0 MALE 3
1 FEMALE 3

Fig.32

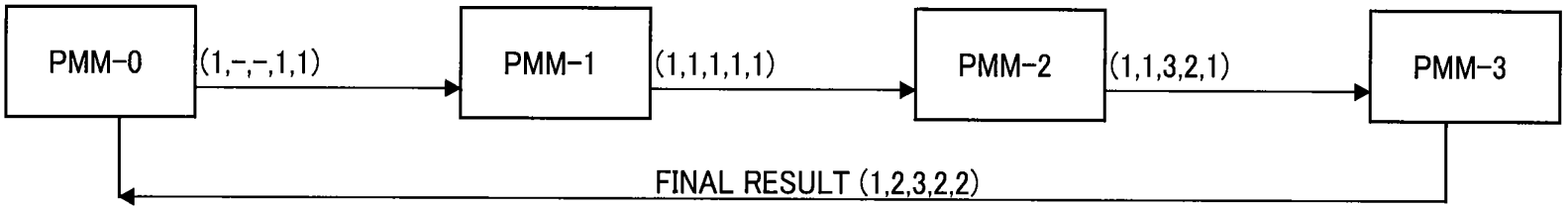

Fig.33

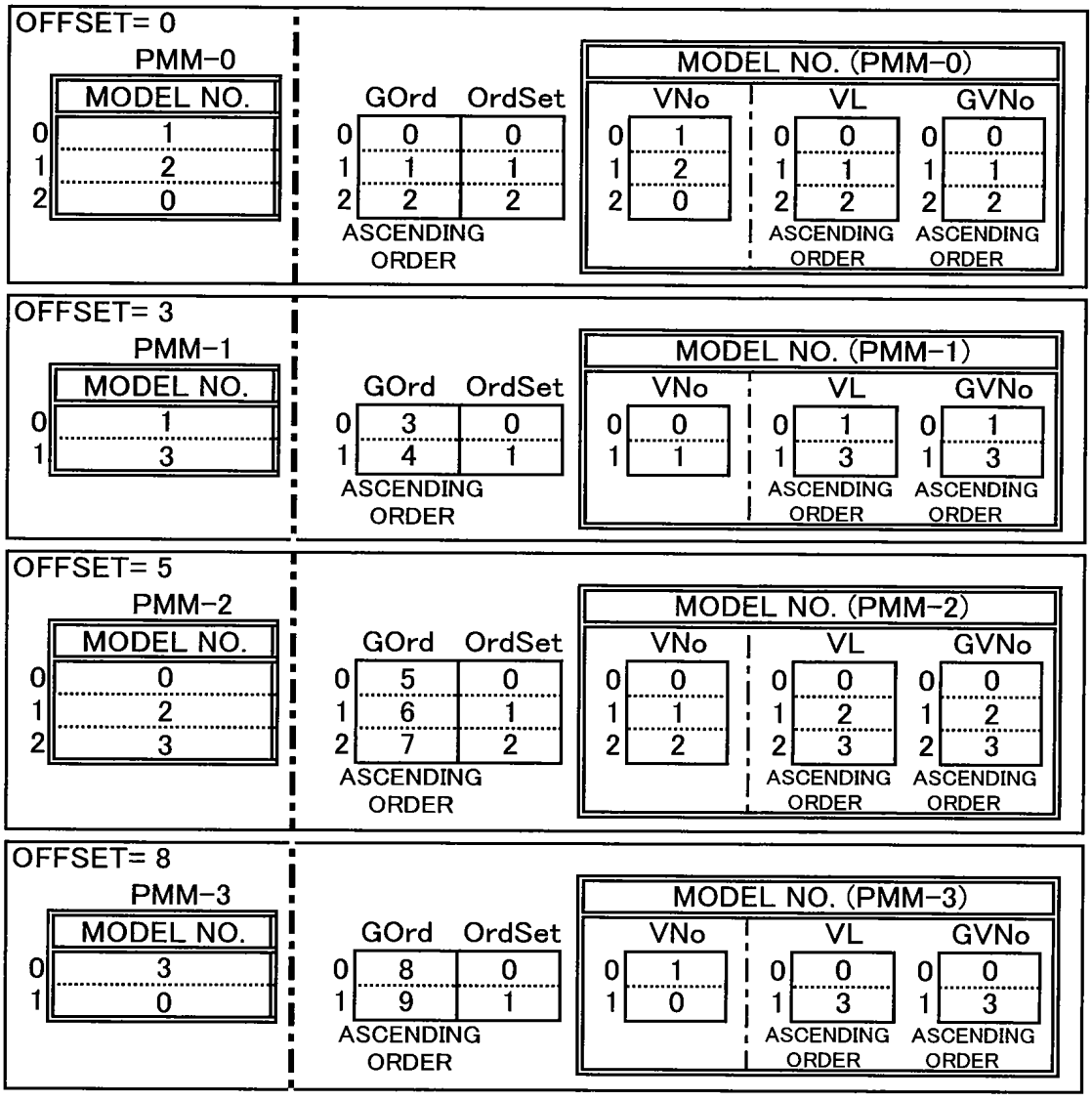
OFFSET= 0
PMM-0
MODEL NO.
0 1
1 2
2 0
GOrd OrdSet
0 0 0
1 1 1
2 2 2
ASCENDING ORDER
MODEL NO. (PMM-0)
VNo
0 1
1 2
2 0
VL
0 0
1 1
2 2
ASCENDING ORDER
GVNo
0 0
1 1
2 2
ASCENDING ORDER
OFFSET= 3
PMM-1
MODEL NO.
0 1
1 3
GOrd OrdSet
0 3 0
1 4 1
ASCENDING ORDER
MODEL NO. (PMM-1)
VNo
0 0
1 1
VL
0 1
1 3
ASCENDING ORDER
GVNo
0 1
1 3
ASCENDING ORDER
OFFSET= 5
PMM-2
MODEL NO.
0 0
1 2
2 3
GOrd OrdSet
0 5 0
1 6 1
2 7 2
ASCENDING ORDER
MODEL NO. (PMM-2)
VNo
0 0
1 1
2 2
VL
0 0
1 2
2 3
ASCENDING ORDER
GVNo
0 0
1 2
2 3
ASCENDING ORDER
OFFSET= 8
PMM-3
MODEL NO.
0 3
1 0
GOrd OrdSet
0 8 0
1 9 1
ASCENDING ORDER
MODEL NO. (PMM-3)
VNo
0 1
1 0
VL
0 0
1 3
ASCENDING ORDER
GVNo
0 0
1 3
ASCENDING ORDER

Fig.34

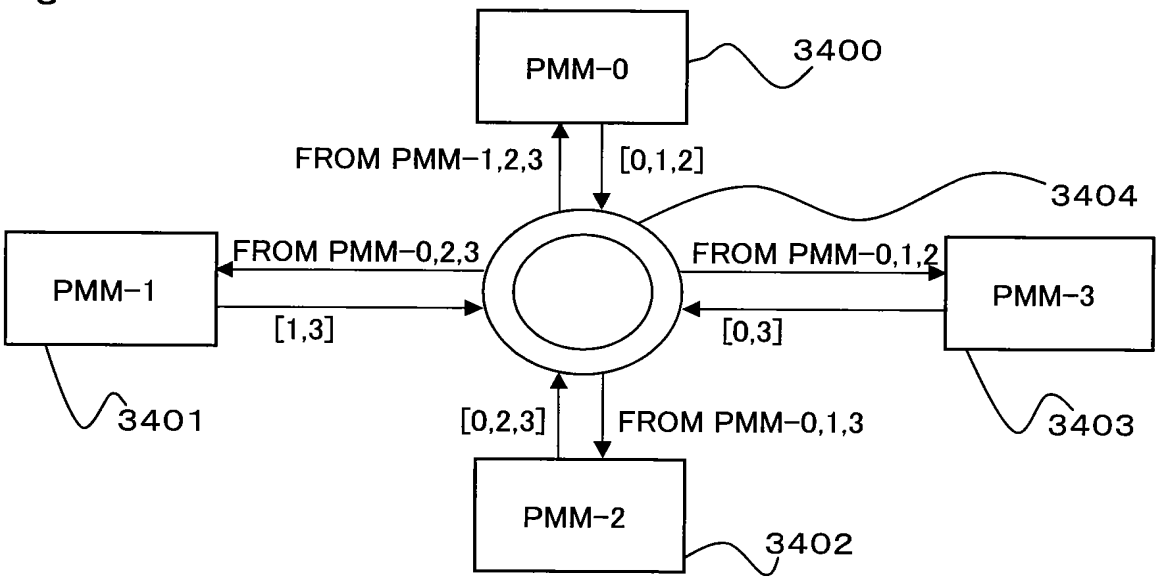
PMM-0
3400
FROM PMM-1,2,3
[0,1,2]
3404
PMM-1
FROM PMM-0,2,3
[1,3]
FROM PMM-0,1,2
[0,3]
PMM-3
3401
[0,2,3]
FROM PMM-0,1,3
3403
PMM-2
3402

Fig.35

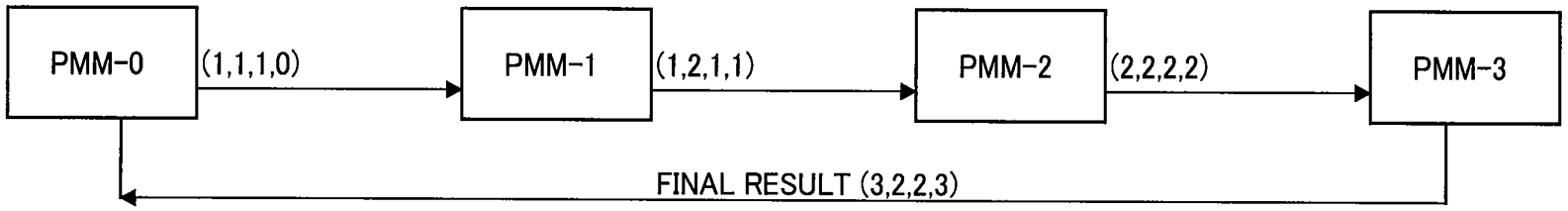

Fig.36

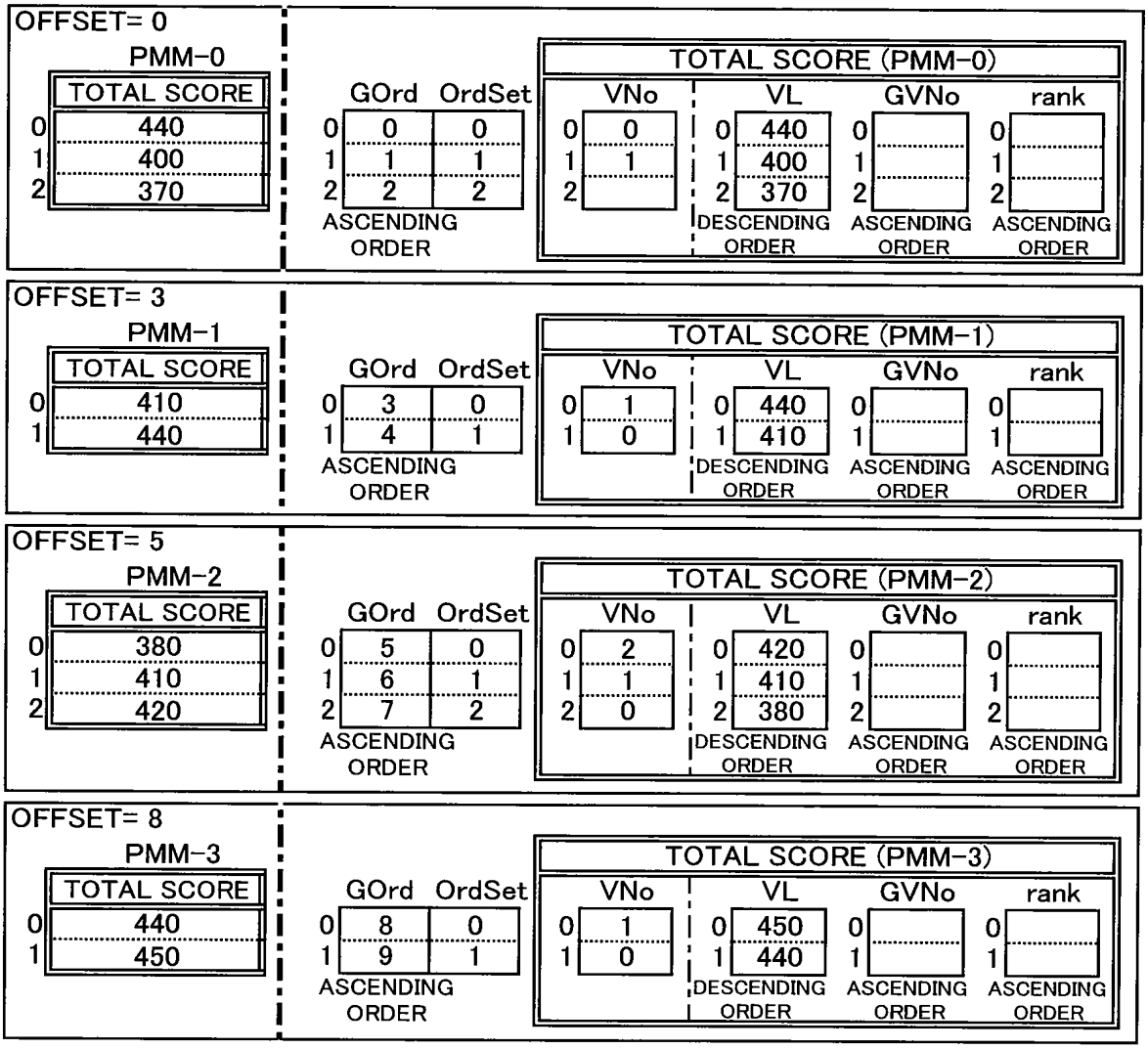
OFFSET= 0
PMM-0
TOTAL SCORE
0 440
1 400
2 370
GOrd OrdSet
0 0 0
1 1 1
2 2 2
ASCENDING ORDER
TOTAL SCORE (PMM-0)
VNo
0 0
1 1
2
VL
0 440
1 400
2 370
DESCENDING ORDER
GVNo
ASCENDING ORDER
rank
ASCENDING ORDER
OFFSET= 3
PMM-1
TOTAL SCORE
0 410
1 440
GOrd OrdSet
0 3 0
1 4 1
ASCENDING ORDER
TOTAL SCORE (PMM-1)
VNo
0 1
1 0
VL
0 440
1 410
DESCENDING ORDER
GVNo
ASCENDING ORDER
rank
ASCENDING ORDER
OFFSET= 5
PMM-2
TOTAL SCORE
0 380
1 410
2 420
GOrd OrdSet
0 5 0
1 6 1
2 7 2
ASCENDING ORDER
TOTAL SCORE (PMM-2)
VNo
0 2
1 1
2 0
VL
0 420
1 410
2 380
DESCENDING ORDER
GVNo
ASCENDING ORDER
rank
ASCENDING ORDER
OFFSET= 8
PMM-3
TOTAL SCORE
0 440
1 450
GOrd OrdSet
0 8 0
1 9 1
ASCENDING ORDER
TOTAL SCORE (PMM-3)
VNo
0 1
1 0
VL
0 450
1 440
DESCENDING ORDER
GVNo
ASCENDING ORDER
rank
ASCENDING ORDER

Fig.37A

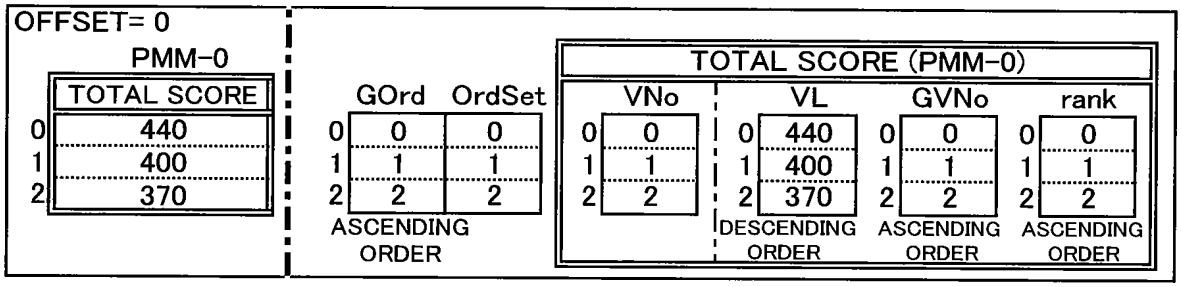

Fig.37B

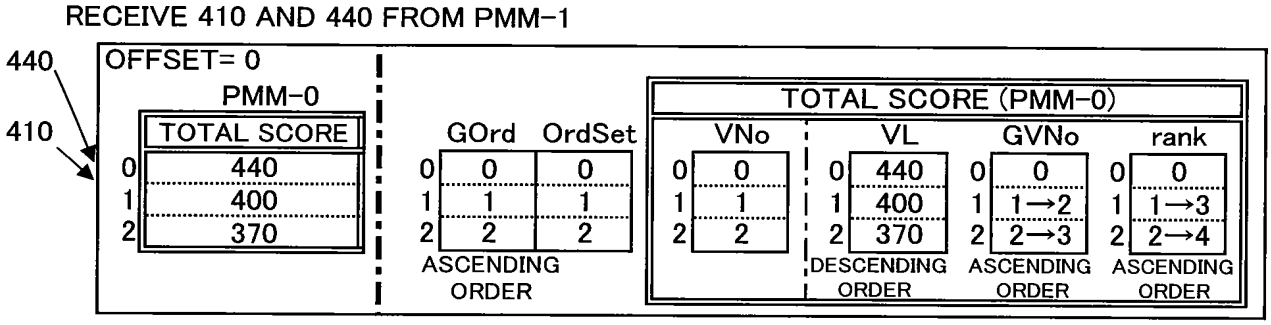

Fig.37C

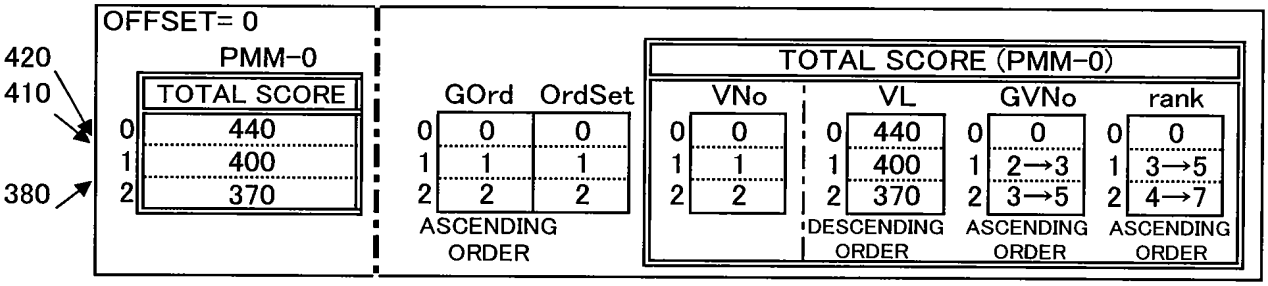

Fig.37D

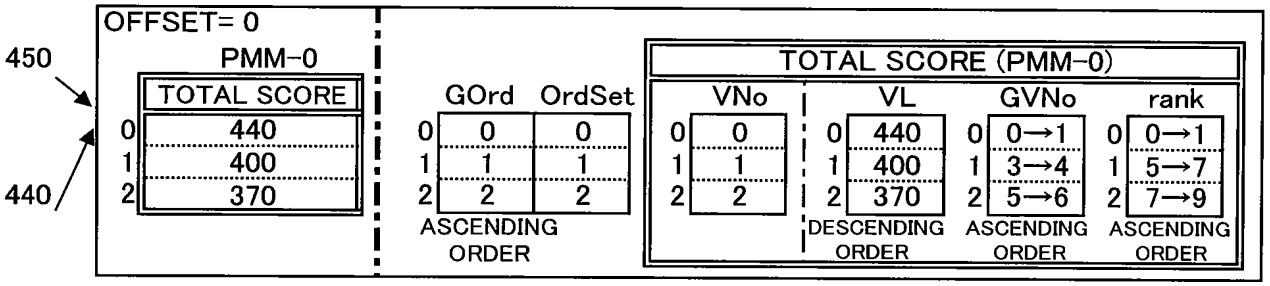

Fig.38

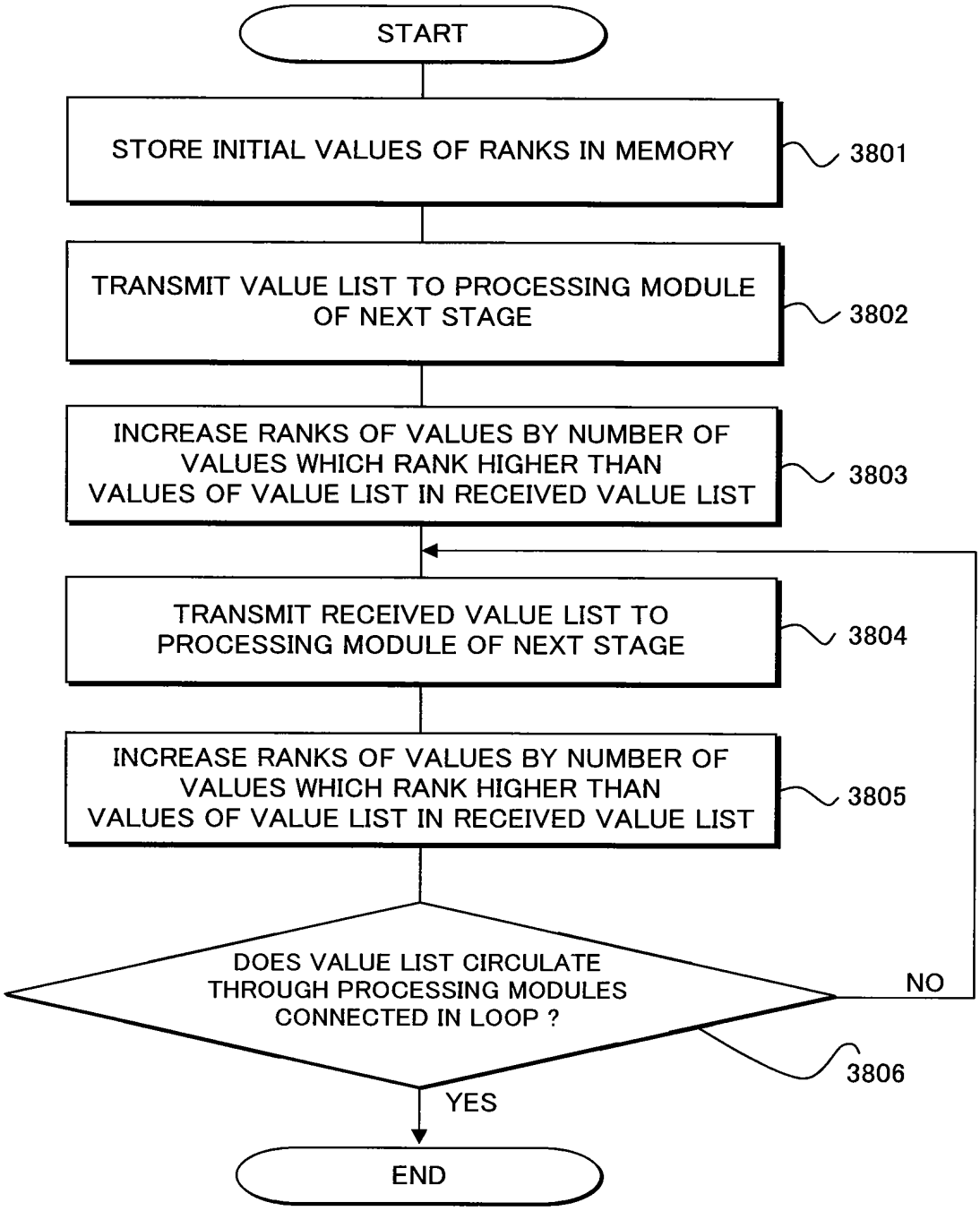
START
STORE INITIAL VALUES OF RANKS IN MEMORY
3801
TRANSMIT VALUE LIST TO PROCESSING MODULE OF NEXT STAGE
3802
INCREASE RANKS OF VALUES BY NUMBER OF VALUES WHICH RANK HIGHER THAN VALUES OF VALUE LIST IN RECEIVED VALUE LIST
3803
TRANSMIT RECEIVED VALUE LIST TO PROCESSING MODULE OF NEXT STAGE
3804
INCREASE RANKS OF VALUES BY NUMBER OF VALUES WHICH RANK HIGHER THAN VALUES OF VALUE LIST IN RECEIVED VALUE LIST
3805
DOES VALUE LIST CIRCULATE THROUGH PROCESSING MODULES CONNECTED IN LOOP ?
NO
3806
YES
END

Fig.39A

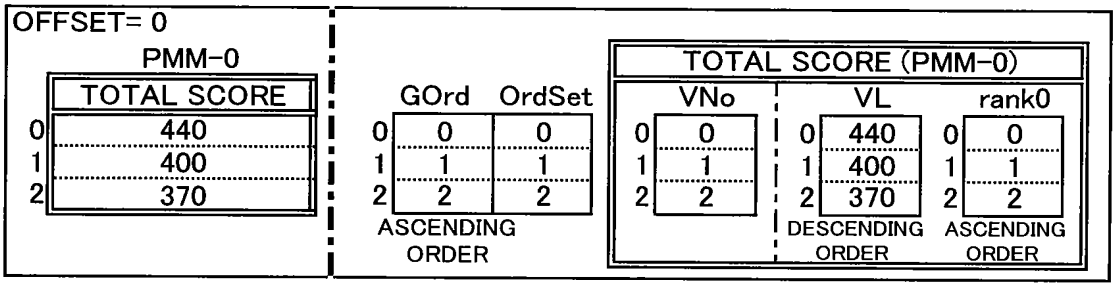

Fig.39B

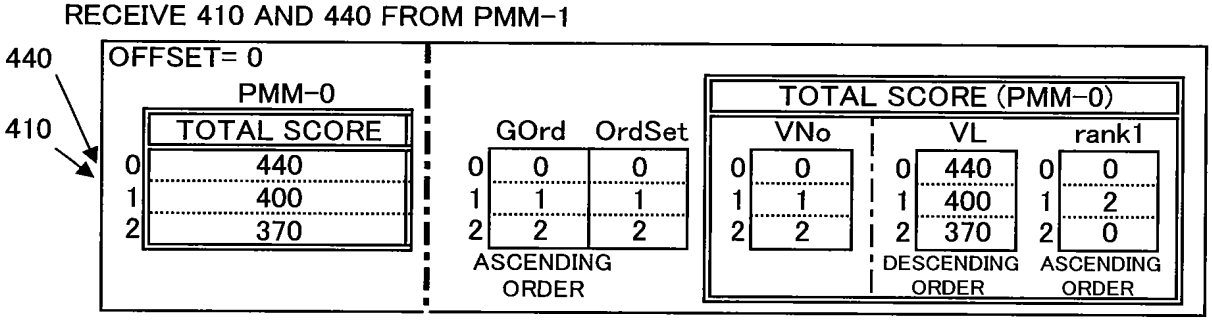

Fig.39C

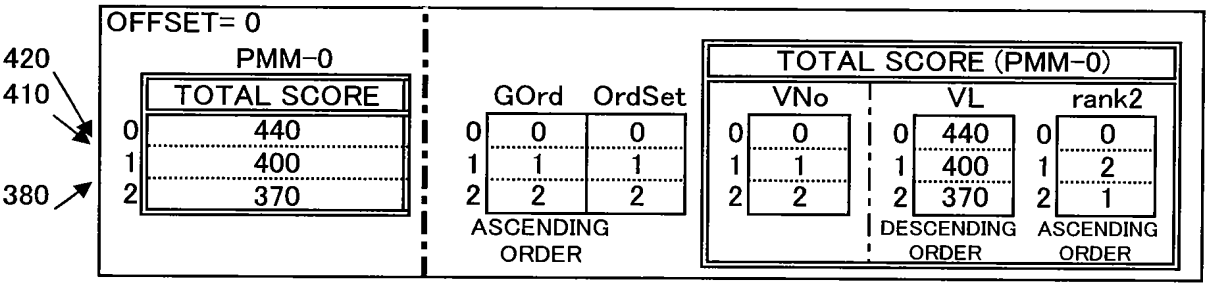

Fig.39D

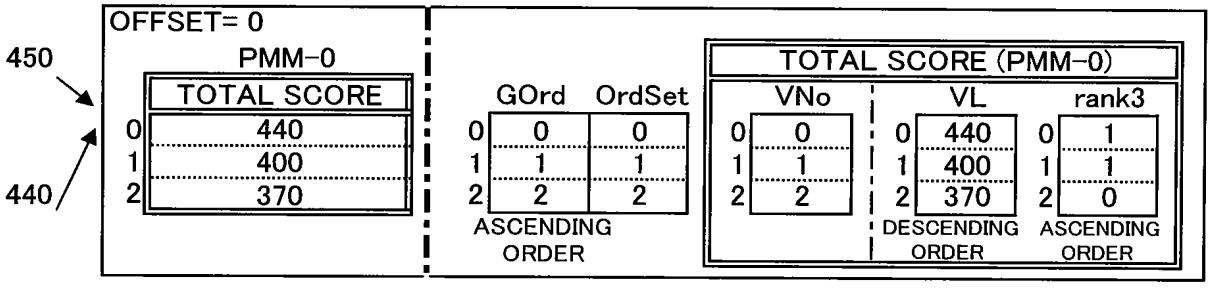

Fig.39E

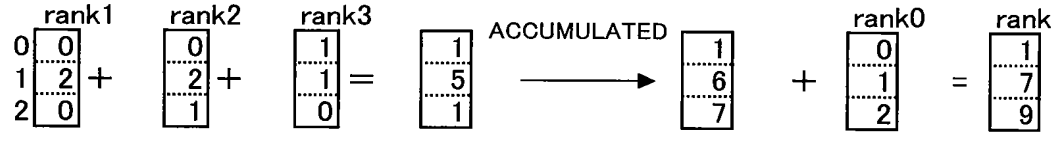

Fig.40

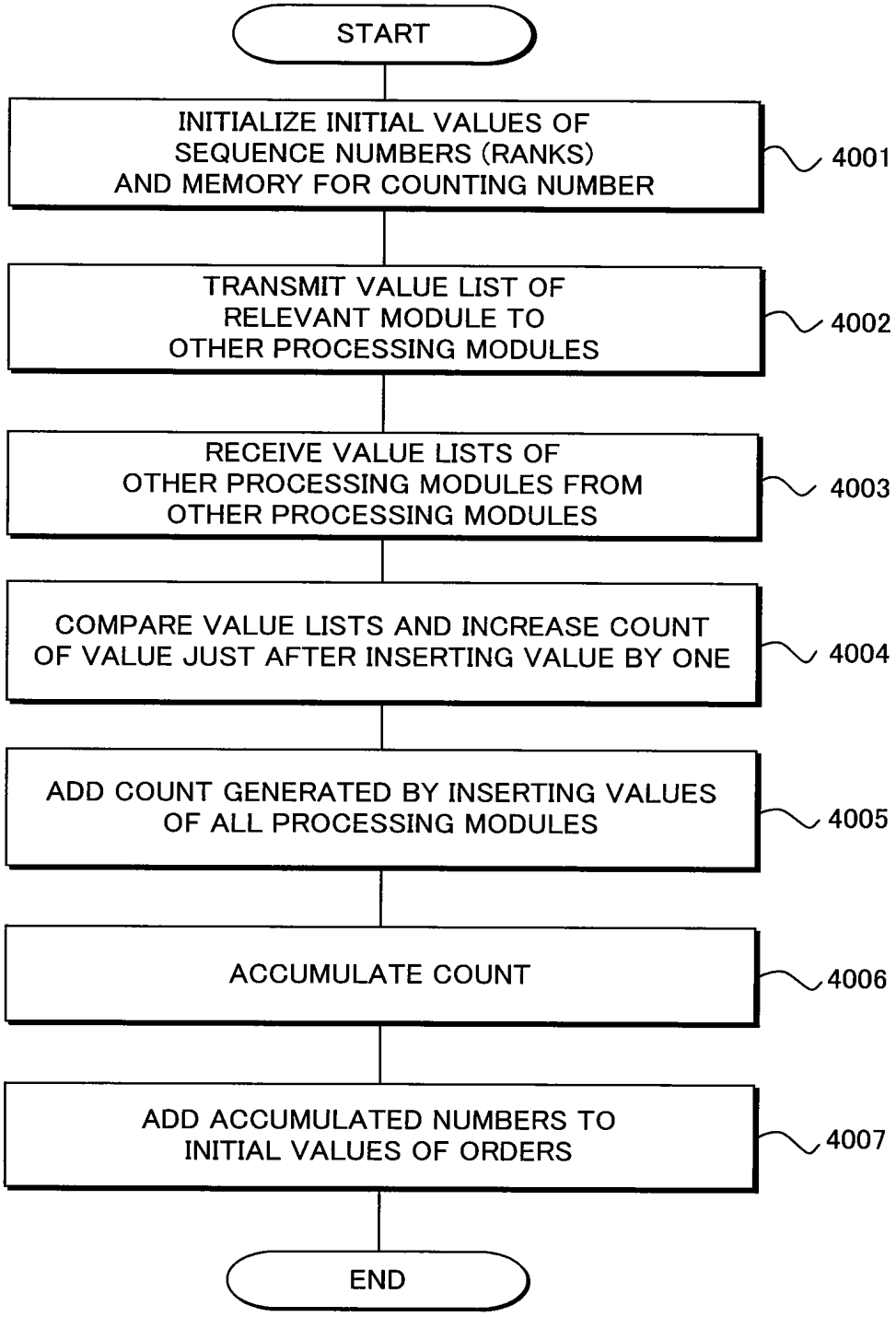
START
INITIALIZE INITIAL VALUES OF SEQUENCE NUMBERS (RANKS) AND MEMORY FOR COUNTING NUMBER
4001
TRANSMIT VALUE LIST OF RELEVANT MODULE TO OTHER PROCESSING MODULES
4002
RECEIVE VALUE LISTS OF OTHER PROCESSING MODULES FROM OTHER PROCESSING MODULES
4003
COMPARE VALUE LISTS AND INCREASE COUNT OF VALUE JUST AFTER INSERTING VALUE BY ONE
4004
ADD COUNT GENERATED BY INSERTING VALUES OF ALL PROCESSING MODULES
4005
ACCUMULATE COUNT
4006
ADD ACCUMULATED NUMBERS TO INITIAL VALUES OF ORDERS
4007
END

Fig.41A

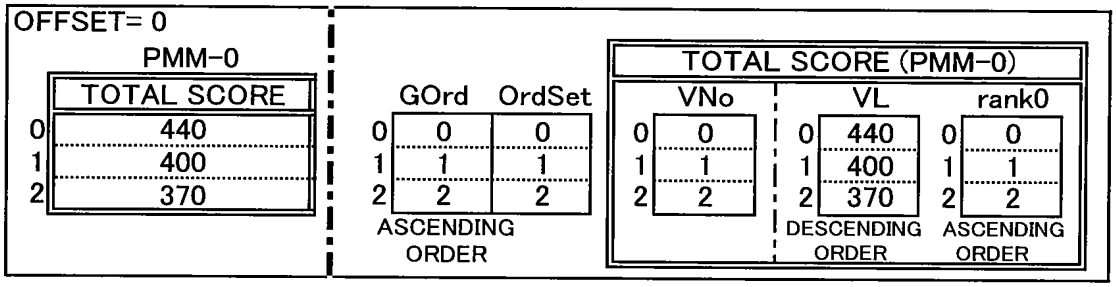

Fig.41B

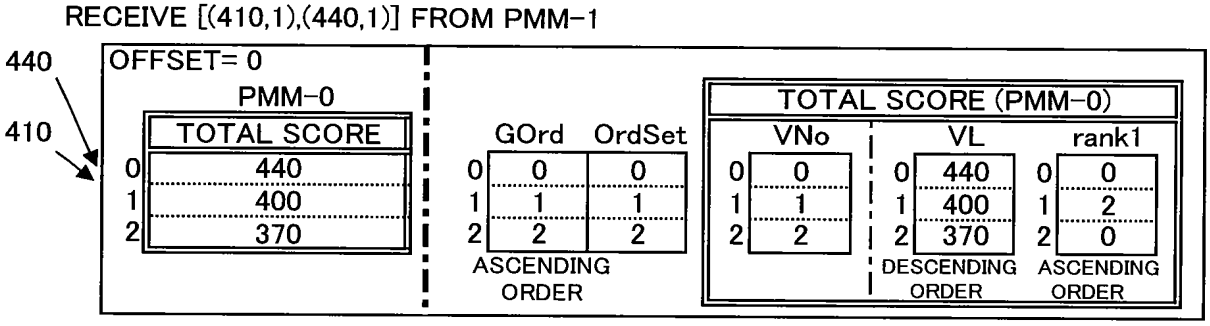

Fig.41C

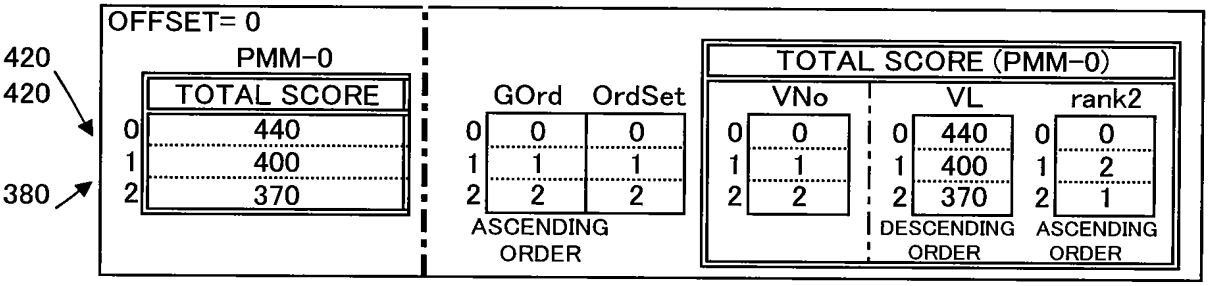

Fig.41D

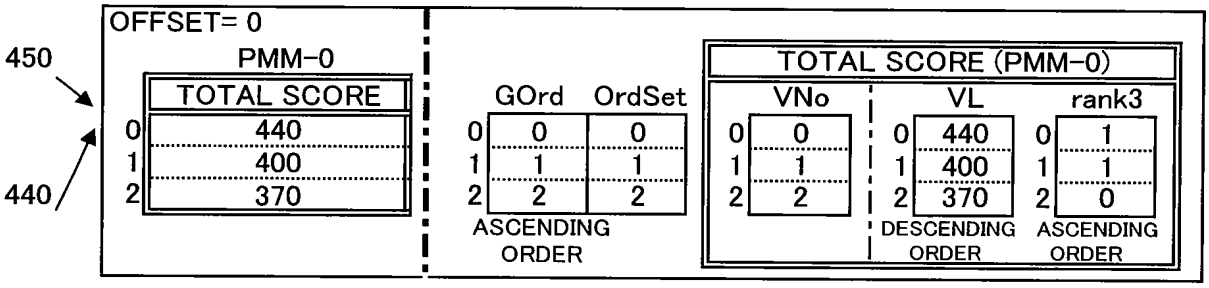

Fig.41E

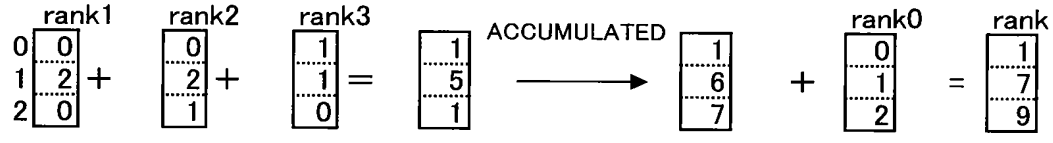

Fig.42

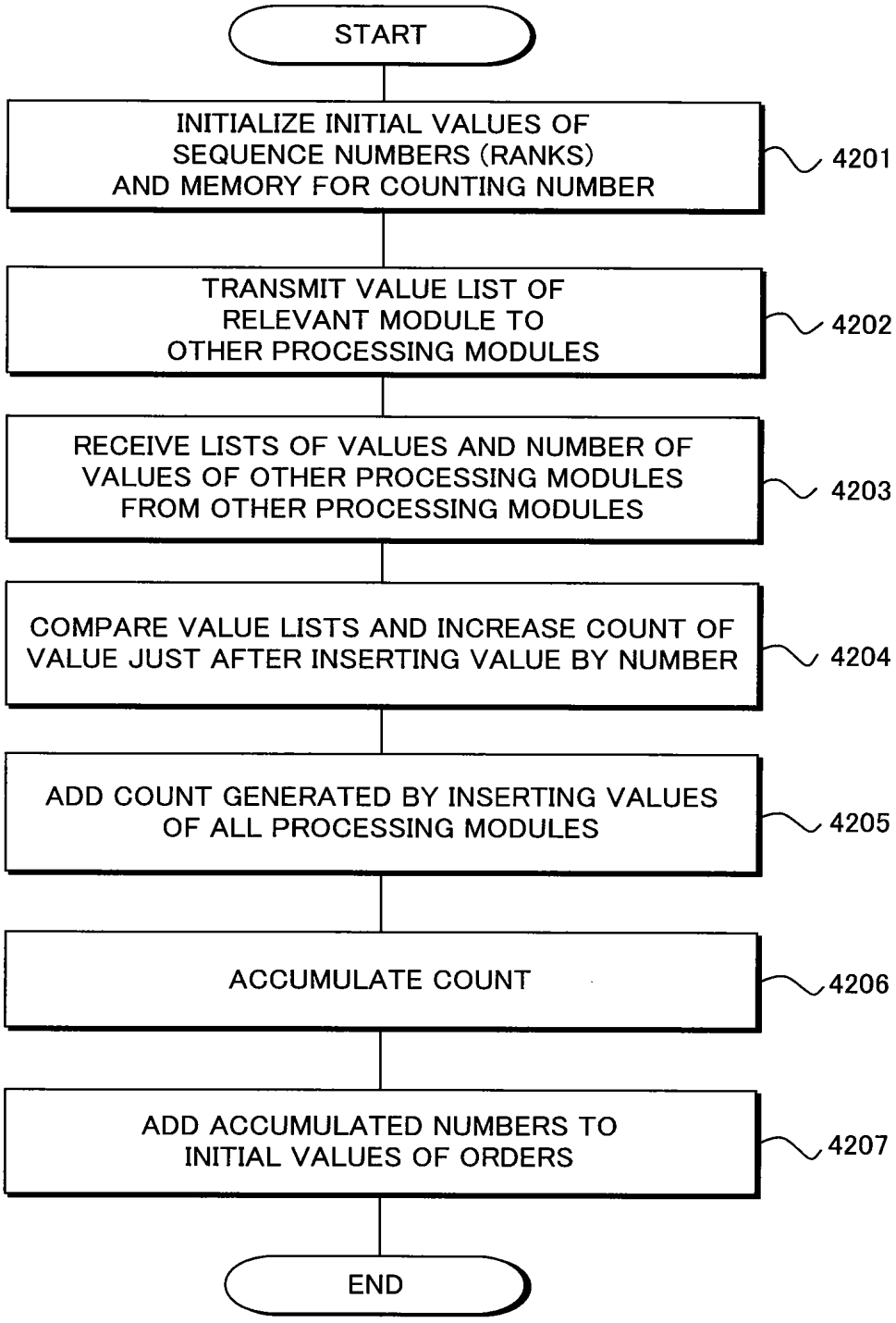
START
INITIALIZE INITIAL VALUES OF SEQUENCE NUMBERS (RANKS) AND MEMORY FOR COUNTING NUMBER
4201
TRANSMIT VALUE LIST OF RELEVANT MODULE TO OTHER PROCESSING MODULES
4202
RECEIVE LISTS OF VALUES AND NUMBER OF VALUES OF OTHER PROCESSING MODULES FROM OTHER PROCESSING MODULES
4203
COMPARE VALUE LISTS AND INCREASE COUNT OF VALUE JUST AFTER INSERTING VALUE BY NUMBER
4204
ADD COUNT GENERATED BY INSERTING VALUES OF ALL PROCESSING MODULES
4205
ACCUMULATE COUNT
4206
ADD ACCUMULATED NUMBERS TO INITIAL VALUES OF ORDERS
4207
END

Fig.43

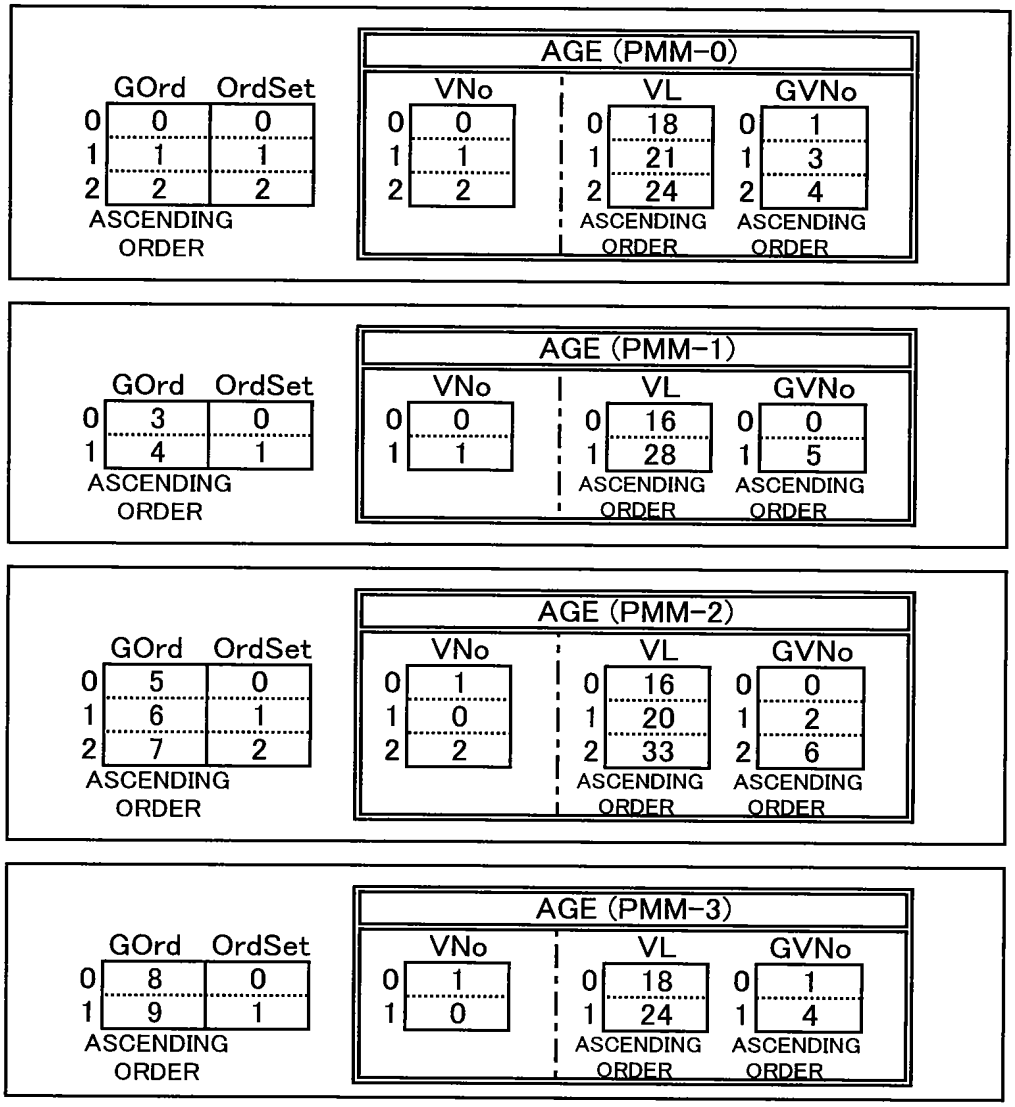
GOrd
OrdSet
0 0 0
1 1 1
2 2 2
ASCENDING ORDER
AGE (PMM-0)
VNo
0 0
1 1
2 2
VL
0 18
1 21
2 24
ASCENDING ORDER
GVNo
0 1
1 3
2 4
ASCENDING ORDER
GOrd
OrdSet
0 3 0
1 4 1
ASCENDING ORDER
AGE (PMM-1)
VNo
0 0
1 1
VL
0 16
1 28
ASCENDING ORDER
GVNo
0 0
1 5
ASCENDING ORDER
GOrd
OrdSet
0 5 0
1 6 1
2 7 2
ASCENDING ORDER
AGE (PMM-2)
VNo
0 1
1 0
2 2
VL
0 16
1 20
2 33
ASCENDING ORDER
GVNo
0 0
1 2
2 6
ASCENDING ORDER
GOrd
OrdSet
0 8 0
1 9 1
ASCENDING ORDER
AGE (PMM-3)
VNo
0 1
1 0
VL
0 18
1 24
ASCENDING ORDER
GVNo
0 1
1 4
ASCENDING ORDER

Fig.44

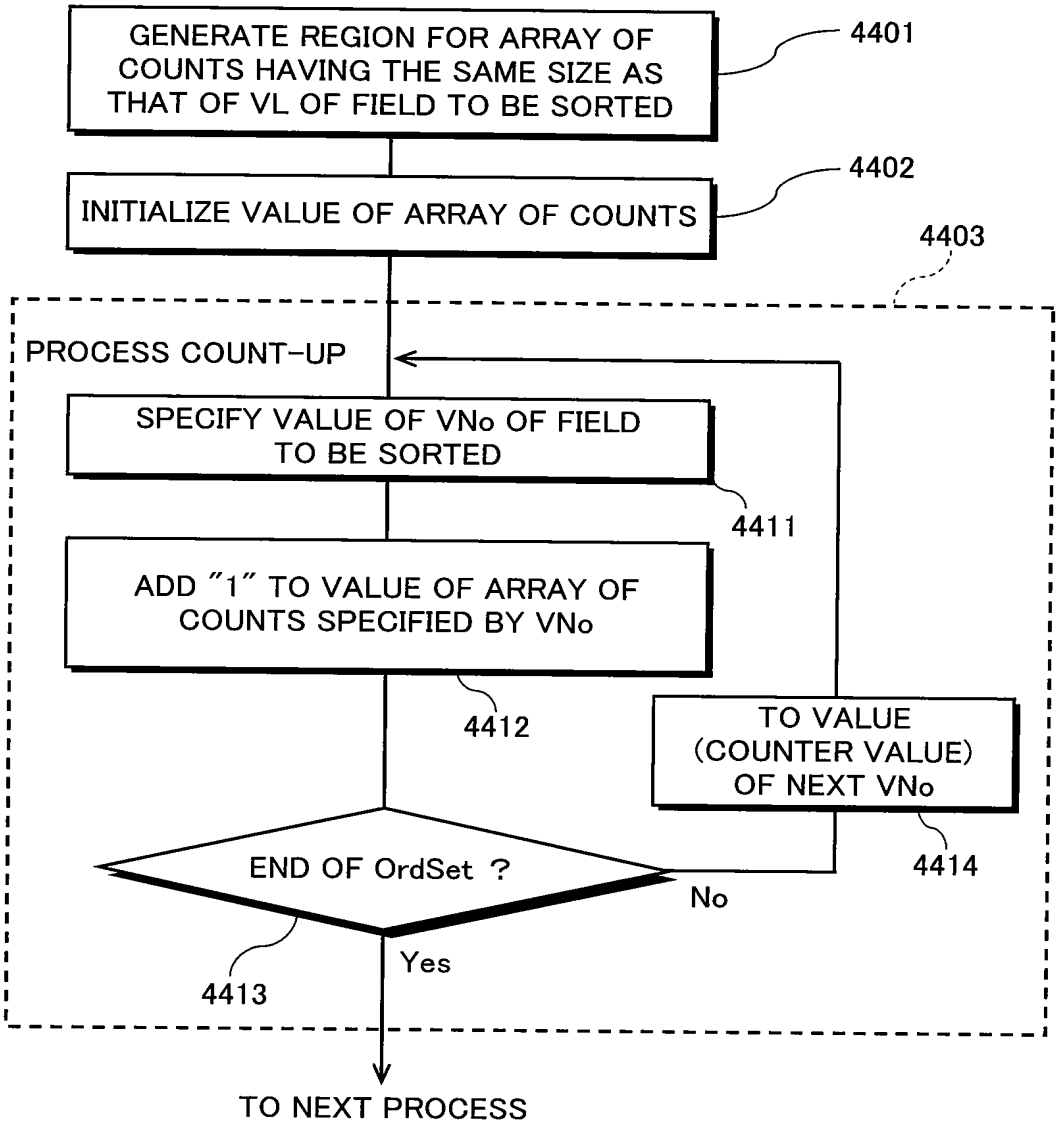
GENERATE REGION FOR ARRAY OF COUNTS HAVING THE SAME SIZE AS THAT OF VL OF FIELD TO BE SORTED
4401
INITIALIZE VALUE OF ARRAY OF COUNTS
4402
4403
PROCESS COUNT-UP
SPECIFY VALUE OF VNo OF FIELD TO BE SORTED
4411
ADD "1" TO VALUE OF ARRAY OF COUNTS SPECIFIED BY VNo
4412
TO VALUE (COUNTER VALUE) OF NEXT VNo
4414
END OF OrdSet ?
No
Yes
4413
TO NEXT PROCESS

Fig.45

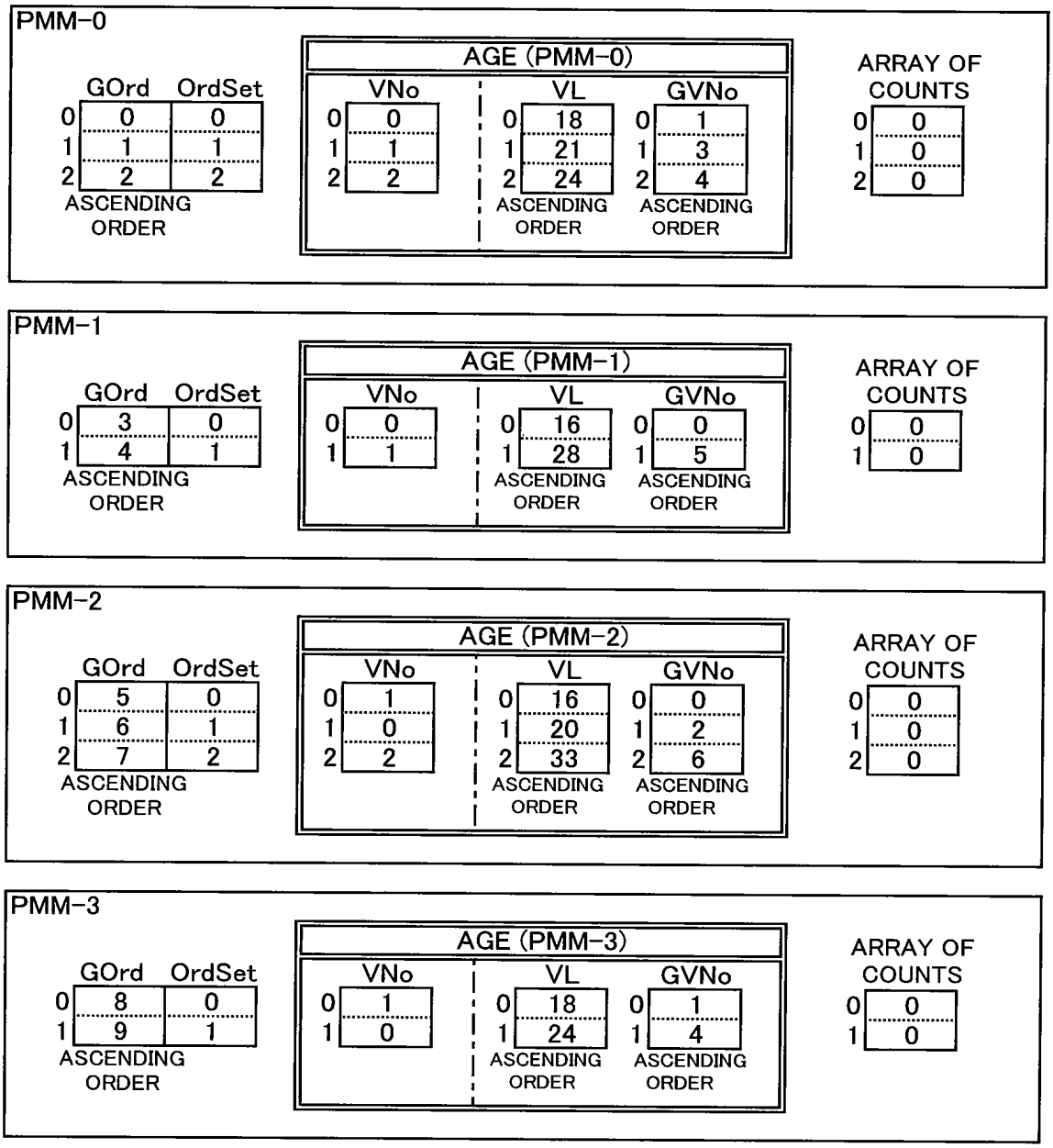
PMM-0
GOrd
OrdSet
0 0 0
1 1 1
2 2 2
ASCENDING ORDER
AGE (PMM-0)
VNo
0 0
1 1
2 2
VL
0 18
1 21
2 24
ASCENDING ORDER
GVNo
0 1
1 3
2 4
ASCENDING ORDER
ARRAY OF COUNTS
0 0
1 0
2 0
PMM-1
GOrd
OrdSet
0 3 0
1 4 1
ASCENDING ORDER
AGE (PMM-1)
VNo
0 0
1 1
VL
0 16
1 28
ASCENDING ORDER
GVNo
0 0
1 5
ASCENDING ORDER
ARRAY OF COUNTS
0 0
1 0
PMM-2
GOrd
OrdSet
0 5 0
1 6 1
2 7 2
ASCENDING ORDER
AGE (PMM-2)
VNo
0 1
1 0
2 2
VL
0 16
1 20
2 33
ASCENDING ORDER
GVNo
0 0
1 2
2 6
ASCENDING ORDER
ARRAY OF COUNTS
0 0
1 0
2 0
PMM-3
GOrd
OrdSet
0 8 0
1 9 1
ASCENDING ORDER
AGE (PMM-3)
VNo
0 1
1 0
VL
0 18
1 24
ASCENDING ORDER
GVNo
0 1
1 4
ASCENDING ORDER
ARRAY OF COUNTS
0 0
1 0

Fig.46

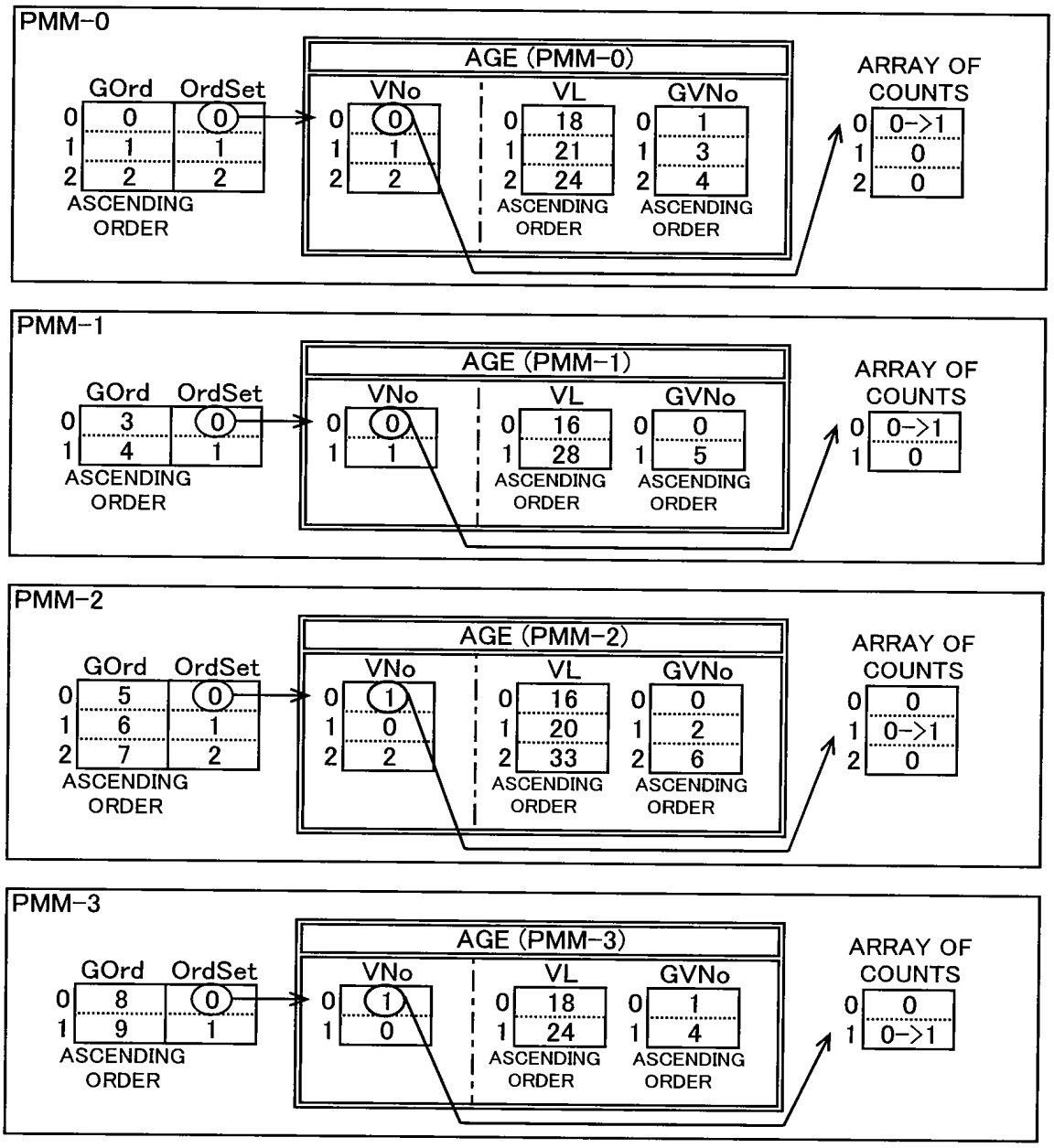
PMM-0
GOrd
OrdSet
0 0 0
1 1 1
2 2 2
ASCENDING ORDER
AGE (PMM-0)
VNo
0 0
1 1
2 2
VL
0 18
1 21
2 24
ASCENDING ORDER
GVNo
0 1
1 3
2 4
ASCENDING ORDER
ARRAY OF COUNTS
0 0->1
1 0
2 0
PMM-1
GOrd
OrdSet
0 3 0
1 4 1
ASCENDING ORDER
AGE (PMM-1)
VNo
0 0
1 1
VL
0 16
1 28
ASCENDING ORDER
GVNo
0 0
1 5
ASCENDING ORDER
ARRAY OF COUNTS
0 0->1
1 0
PMM-2
GOrd
OrdSet
0 5 0
1 6 1
2 7 2
ASCENDING ORDER
AGE (PMM-2)
VNo
0 1
1 0
2 2
VL
0 16
1 20
2 33
ASCENDING ORDER
GVNo
0 0
1 2
2 6
ASCENDING ORDER
ARRAY OF COUNTS
0 0
1 0->1
2 0
PMM-3
GOrd
OrdSet
0 8 0
1 9 1
ASCENDING ORDER
AGE (PMM-3)
VNo
0 1
1 0
VL
0 18
1 24
ASCENDING ORDER
GVNo
0 1
1 4
ASCENDING ORDER
ARRAY OF COUNTS
0 0
1 0->1

Fig.47

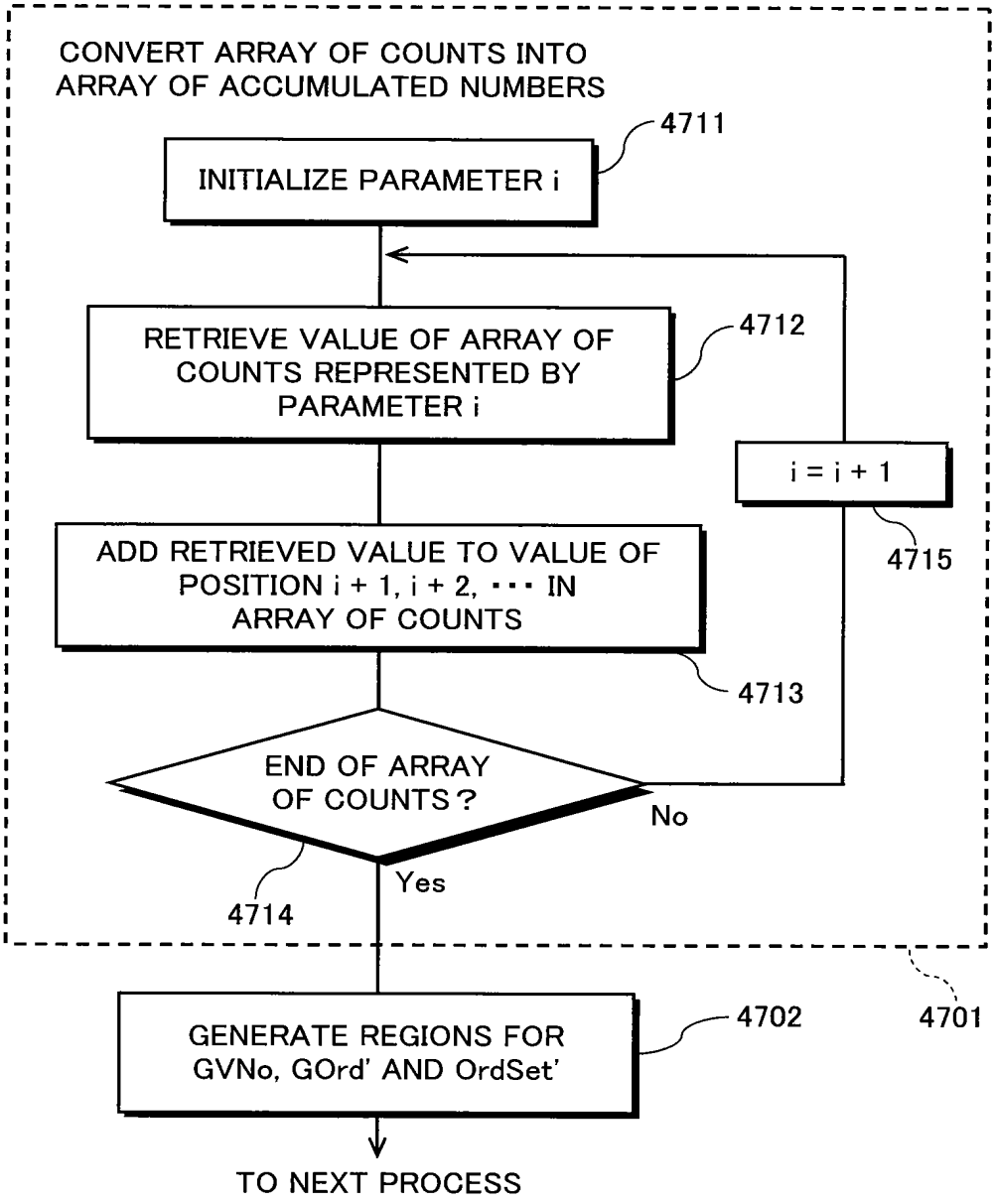
CONVERT ARRAY OF COUNTS INTO ARRAY OF ACCUMULATED NUMBERS
4711
INITIALIZE PARAMETER i
RETRIEVE VALUE OF ARRAY OF COUNTS REPRESENTED BY PARAMETER i
4712
i = i + 1
4715
ADD RETRIEVED VALUE TO VALUE OF POSITION i + 1, i + 2, ··· IN ARRAY OF COUNTS
4713
END OF ARRAY OF COUNTS ?
No
Yes
4714
4701
GENERATE REGIONS FOR GVNo, GOrd' AND OrdSet'
4702
TO NEXT PROCESS

Fig.48

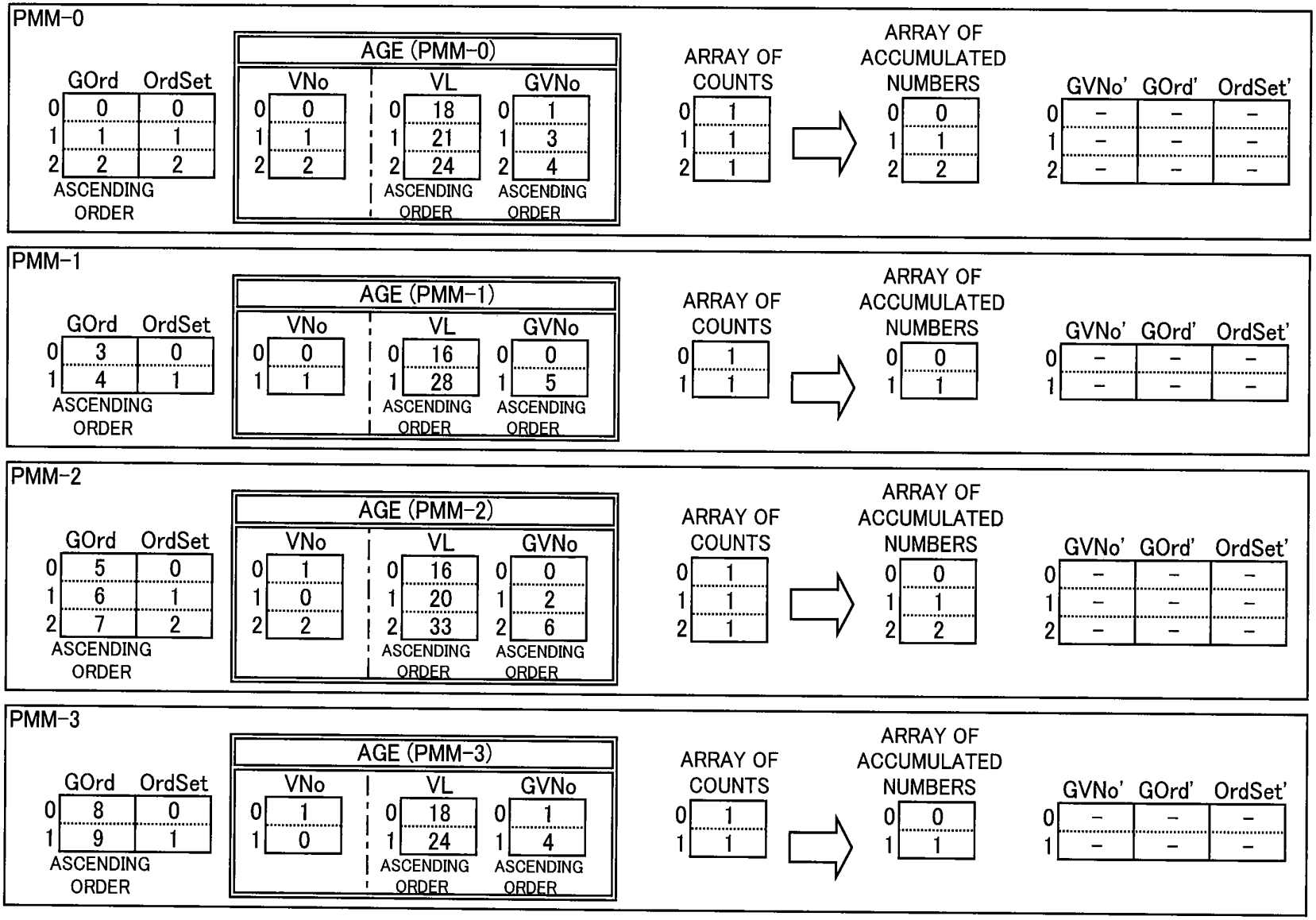
PMM-0
GOrd
OrdSet
0 0 0
1 1 1
2 2 2
ASCENDING ORDER
AGE (PMM-0)
VNo
0 0
1 1
2 2
VL
0 18
1 21
2 24
ASCENDING ORDER
GVNo
0 1
1 3
2 4
ASCENDING ORDER
ARRAY OF COUNTS
0 1
1 1
2 1
ARRAY OF ACCUMULATED NUMBERS
0 0
1 1
2 2
GVNo' GOrd' OrdSet'
0 – – –
1 – – –
2 – – –
PMM-1
GOrd
OrdSet
0 3 0
1 4 1
ASCENDING ORDER
AGE (PMM-1)
VNo
0 0
1 1
VL
0 16
1 28
ASCENDING ORDER
GVNo
0 0
1 5
ASCENDING ORDER
ARRAY OF COUNTS
0 1
1 1
ARRAY OF ACCUMULATED NUMBERS
0 0
1 1
GVNo' GOrd' OrdSet'
0 – – –
1 – – –
PMM-2
GOrd
OrdSet
0 5 0
1 6 1
2 7 2
ASCENDING ORDER
AGE (PMM-2)
VNo
0 1
1 0
2 2
VL
0 16
1 20
2 33
ASCENDING ORDER
GVNo
0 0
1 2
2 6
ASCENDING ORDER
ARRAY OF COUNTS
0 1
1 1
2 1
ARRAY OF ACCUMULATED NUMBERS
0 0
1 1
2 2
GVNo' GOrd' OrdSet'
0 – – –
1 – – –
2 – – –
PMM-3
GOrd
OrdSet
0 8 0
1 9 1
ASCENDING ORDER
AGE (PMM-3)
VNo
0 1
1 0
VL
0 18
1 24
ASCENDING ORDER
GVNo
0 1
1 4
ASCENDING ORDER
ARRAY OF COUNTS
0 1
1 1
ARRAY OF ACCUMULATED NUMBERS
0 0
1 1
GVNo' GOrd' OrdSet'
0 – – –
1 – – –

Fig.49

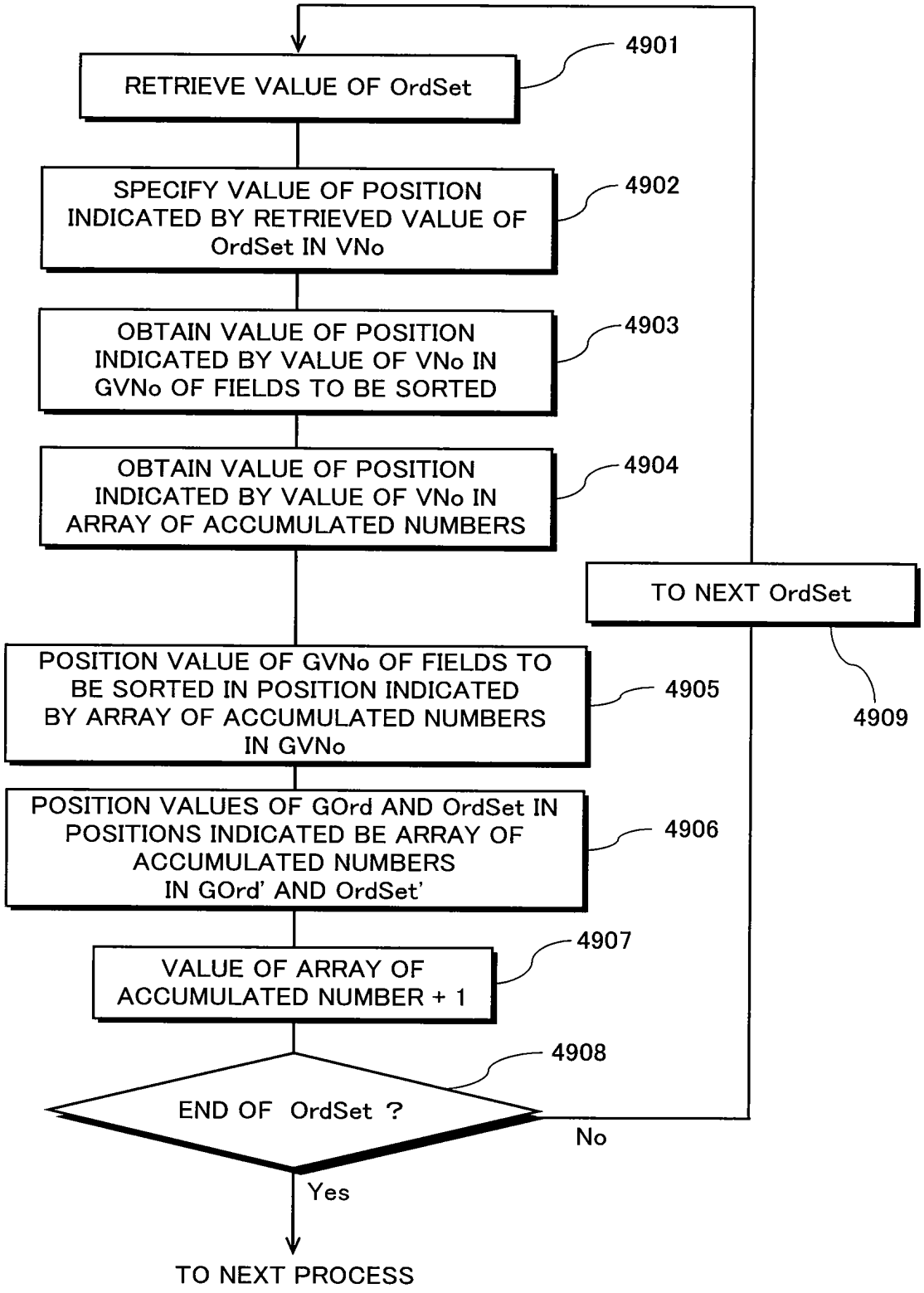
RETRIEVE VALUE OF OrdSet
4901
SPECIFY VALUE OF POSITION INDICATED BY RETRIEVED VALUE OF OrdSet IN VNo
4902
OBTAIN VALUE OF POSITION INDICATED BY VALUE OF VNo IN GVNo OF FIELDS TO BE SORTED
4903
OBTAIN VALUE OF POSITION INDICATED BY VALUE OF VNo IN ARRAY OF ACCUMULATED NUMBERS
4904
TO NEXT OrdSet
4909
POSITION VALUE OF GVNo OF FIELDS TO BE SORTED IN POSITION INDICATED BY ARRAY OF ACCUMULATED NUMBERS IN GVNo
4905
POSITION VALUES OF GOrd AND OrdSet IN POSITIONS INDICATED BE ARRAY OF ACCUMULATED NUMBERS IN GOrd' AND OrdSet'
4906
VALUE OF ARRAY OF ACCUMULATED NUMBER + 1
4907
END OF OrdSet ?
4908
No
Yes
TO NEXT PROCESS

Fig.50

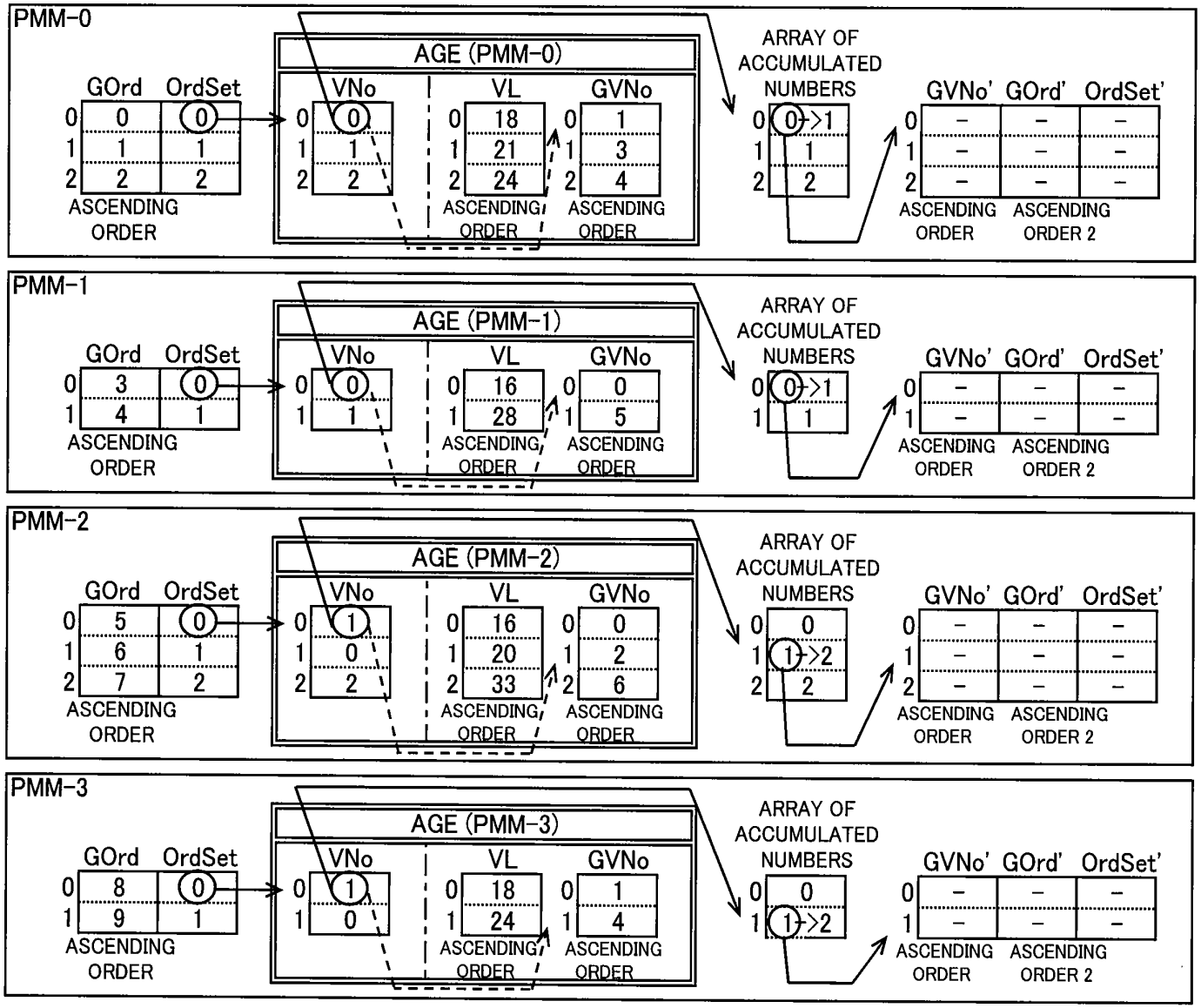
PMM-0
AGE (PMM-0)
GOrd
OrdSet
VNo
VL
GVNo
ARRAY OF ACCUMULATED NUMBERS
GVNo'
GOrd'
OrdSet'
ASCENDING ORDER
ASCENDING ORDER 2
PMM-1
AGE (PMM-1)
PMM-2
AGE (PMM-2)
PMM-3
AGE (PMM-3)

Fig.51

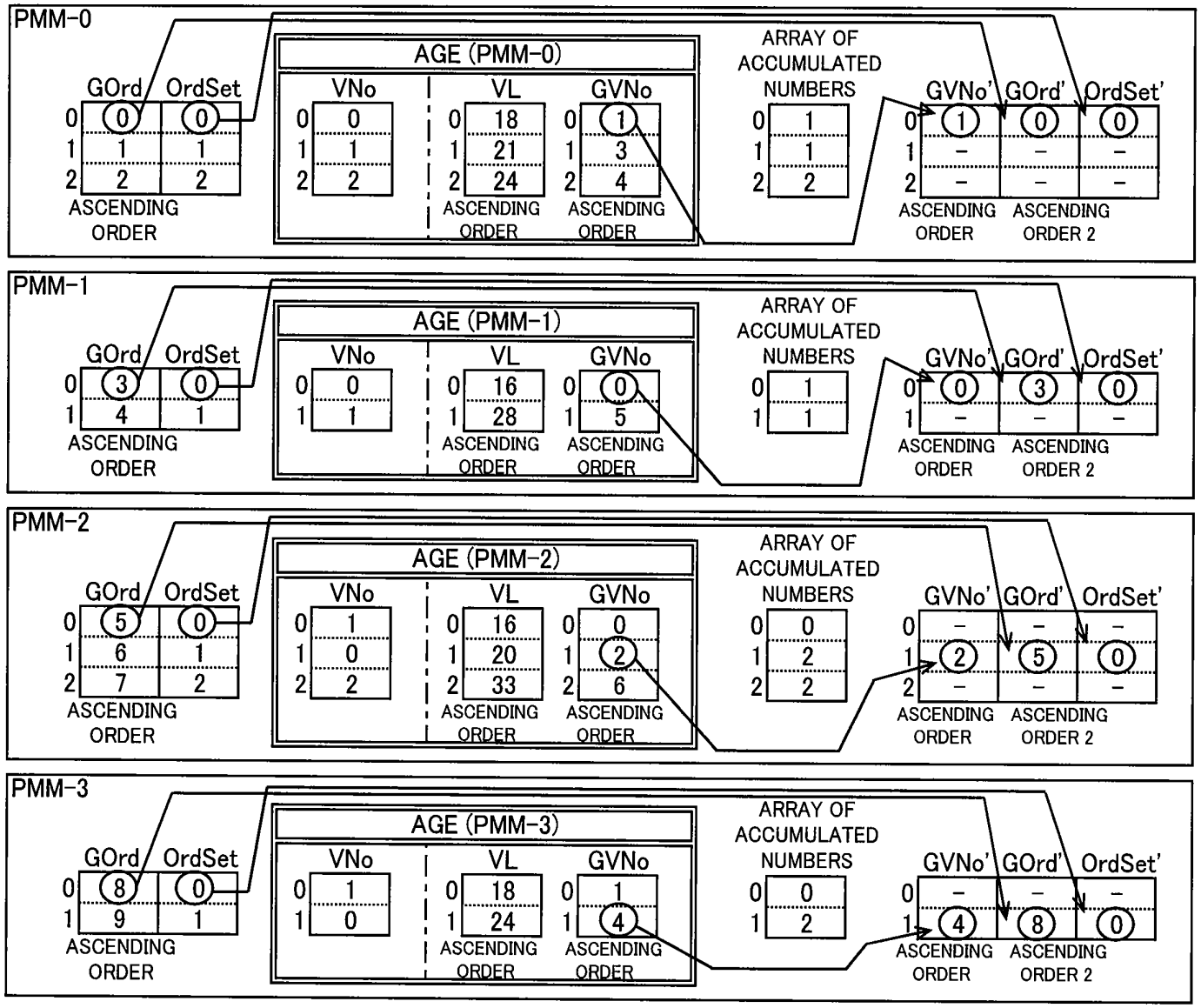
PMM-0
GOrd
OrdSet
ASCENDING ORDER
AGE (PMM-0)
VNo
VL
GVNo
ASCENDING ORDER
ASCENDING ORDER
ARRAY OF ACCUMULATED NUMBERS
GVNo'
GOrd'
OrdSet'
ASCENDING ORDER
ASCENDING ORDER 2
PMM-1
AGE (PMM-1)
PMM-2
AGE (PMM-2)
PMM-3
AGE (PMM-3)

Fig.52

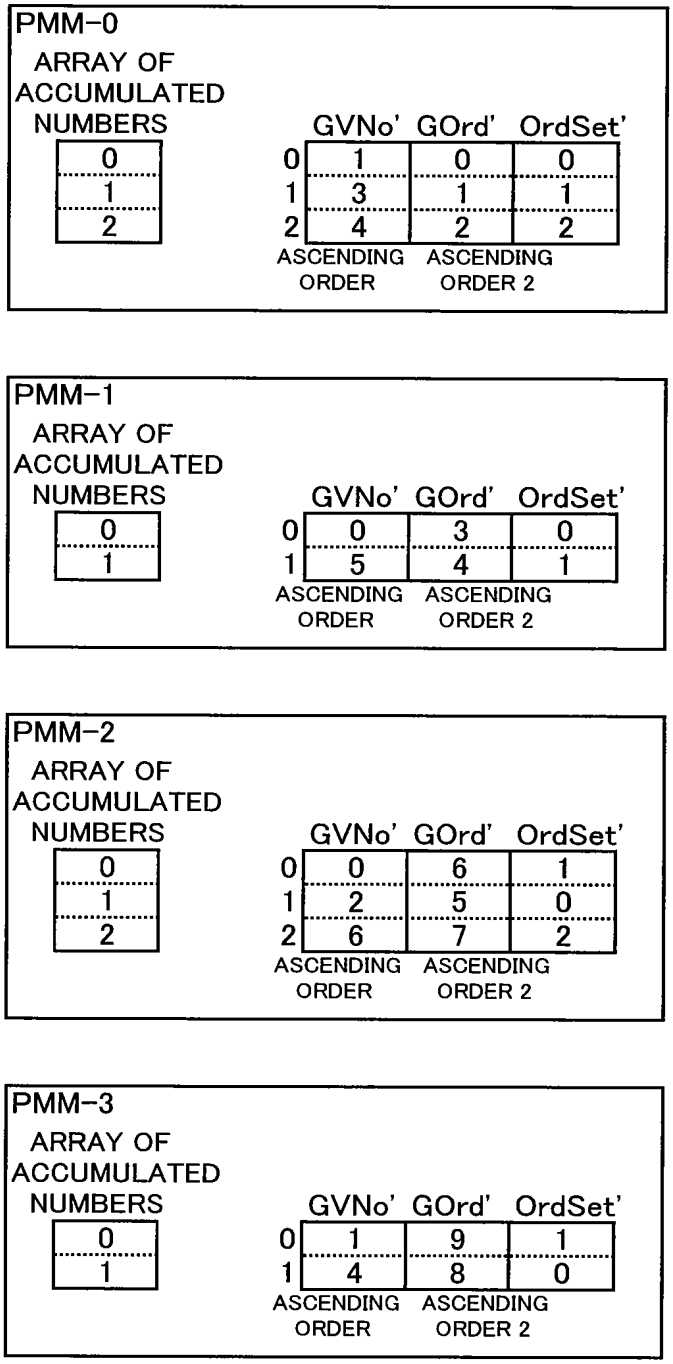
PMM-0
ARRAY OF ACCUMULATED NUMBERS
0
1
2
GVNo' GOrd' OrdSet'
0 1 0 0
1 3 1 1
2 4 2 2
ASCENDING ORDER
ASCENDING ORDER 2
PMM-1
ARRAY OF ACCUMULATED NUMBERS
0
1
GVNo' GOrd' OrdSet'
0 0 3 0
1 5 4 1
ASCENDING ORDER
ASCENDING ORDER 2
PMM-2
ARRAY OF ACCUMULATED NUMBERS
0
1
2
GVNo' GOrd' OrdSet'
0 0 6 1
1 2 5 0
2 6 7 2
ASCENDING ORDER
ASCENDING ORDER 2
PMM-3
ARRAY OF ACCUMULATED NUMBERS
0
1
GVNo' GOrd' OrdSet'
0 1 9 1
1 4 8 0
ASCENDING ORDER
ASCENDING ORDER 2

Fig.53A

GENERATION OF ARRAY

OrdSet	GVNo OF SEX	GVNo OF AGE	GOrd
0	1	2	0
1	0	0	1
2	1	1	2

Fig.53B

INITIALIZATION OF RANKS

OrdSet	RANK
0	0
1	0
2	0

Fig.53C

ASSIGNMENT OF RANK 1

OrdSet	RANK
0	0→1
1	0
2	0→1

Fig.53D

ASSIGNMENT OF RANK 2

OrdSet	RANK
0	1→2
1	0
2	1

Fig.53E

RESULT

RANK	OrdSet	GVNo OF SEX	GVNo OF AGE	GOrd
2	0	1	2	0
0	1	0	0	1
1	2	1	1	2

Fig.53F

RESULT

RANK	OrdSet	GVNo OF SEX	GVNo OF AGE	GOrd
0	1	0	0	1
1	2	1	1	2
2	0	1	2	0